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Concrete Control

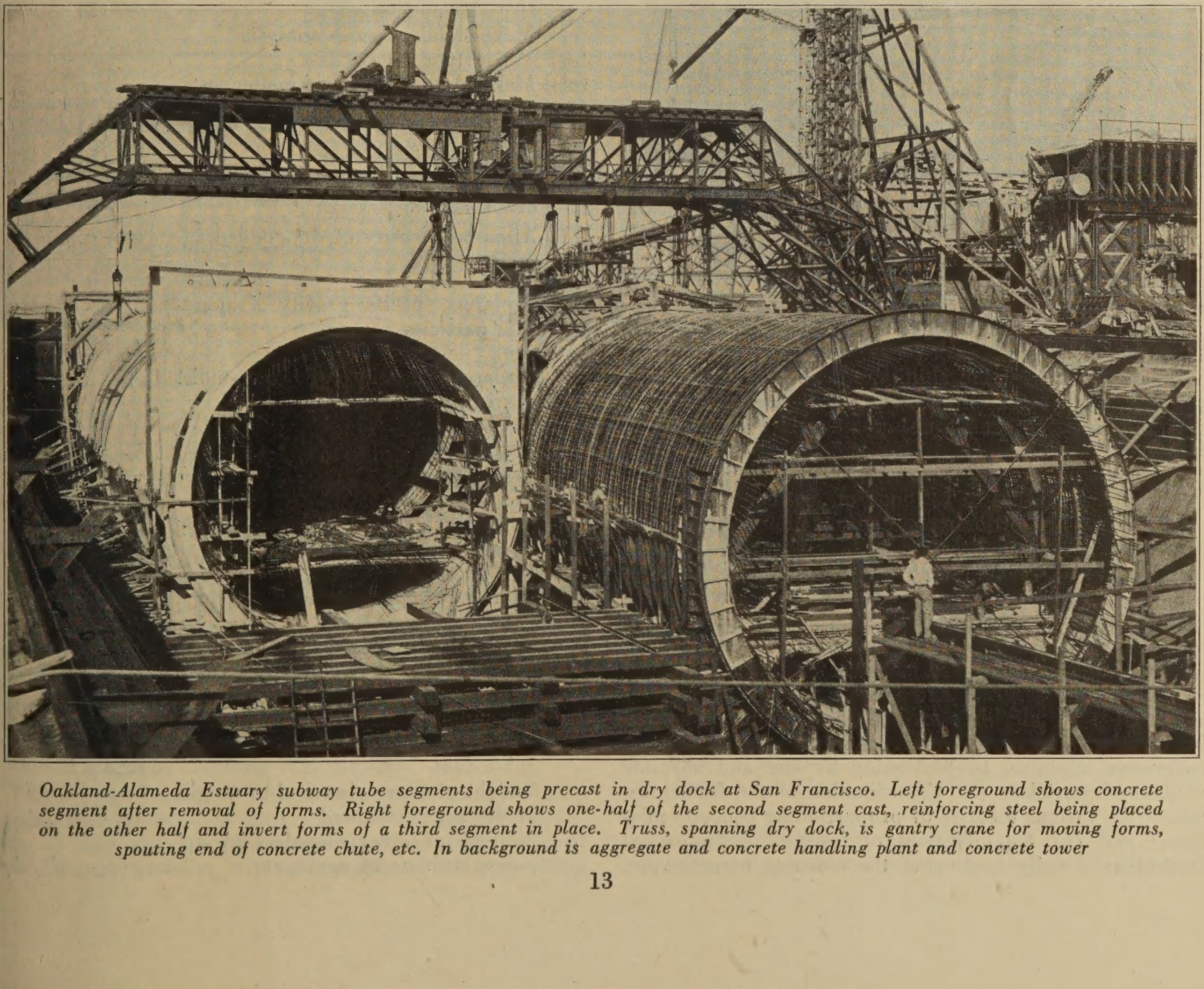
On the Twelve Precast Segments of the Oakland-Alameda Estuary Subway

New Methods of Aggregate and Concrete Testing, Proportioning and Production Control Employed

By JOSEPH A. KITTS
Consulting Concrete Technologist, Kitts & Tuthill, San Francisco

THE Oakland-Alameda Estuary subway ("George A. Posey Tube"), built by Alameda County, California, and recently completed, is one of the outstanding engineering achievements of the decade. It is the first precast concrete underwater tunnel, the largest subaqueous concrete tube in the world.

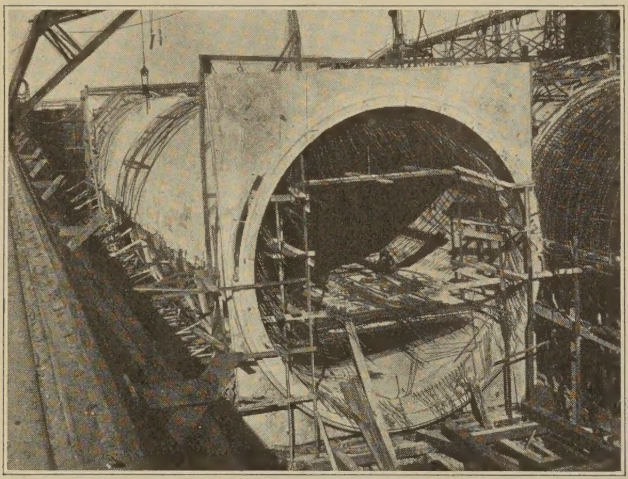
The Estuary subway is a vehicular tunnel connecting the cities of Oakland and Alameda, California. It lies under the water and ship channel of the Oakland Estuary, an arm of San Francisco Bay. It is 3,545 ft. long from portal to portal and 4,437 ft. including the open approaches. The outside diameter is 37 ft. and the bore 32



Oakland-Alameda Estuary subway tube segments being precast in dry dock at San Francisco. Left foreground shows concrete segment after removal of forms. Right foreground shows one-half of the second segment cast, reinforcing steel being placed on the other half and invert forms of a third segment in place. Truss, spanning dry dock, is gantry crane for moving forms, spouting end of concrete chute, etc. In background is aggregate and concrete handling plant and concrete tower ft., the reinforced concrete shell being $2\frac{1}{2}$ ft. thick. It will accommodate a 23-ft. roadway and two $3\frac{1}{2}$-ft. sidewalks. Ventilating ducts are provided above and below the roadway space. Twelve sections 203 ft. long, weighing 5000 tons each, were cast at Hunters' Point dry dock, then floated across San Francisco Bay and finally sunk into place. For the completed tube approximately 75,000 cu. yds. of concrete were required, and 5,000 tons of reinforcing steel.

Concrete Proportioning Control

The cylindrical shaped, closely reinforced shell required concrete of good workability, flowability and cohesion in the fresh mix; the final location of the structure in sea water demanded that the concrete be dense, impermeable and, of course, of ample strength. With due consideration of these conditions and requirements, ample cement was specified by the engineer and provisions were made for controlling the testing, proportioning, mixing and placing of the concrete. For the shell, two barrels of cement per cubic yard of concrete in place and a minimum compressive strength of 2500 lbs. per sq. in. at 28 days were required. For the roadway slab, one and one-half barrels of cement and 2000 lbs. per sq. in. compressive strength were required.



Shows segment cast and forms removed and a second segment partly cast

The aims in the control of the concrete production were: To maintain the required strength (as a minimum); the essential workability, flowability and cohesion in the fresh mix; the highest possible density and impermeability under the conditions; and a uniform concrete with a minimum of honeycomb, of seams between pours, and of shrinkage cracks.

New developments in methods of aggregate and concrete testing, proportioning and production control were employed. These comprise: (1) A compressive physico-mathematics of concrete materials and mixtures; (2) Co-ordination of the tests for the various physical characteristics of aggregates, and co-ordination of aggregate, aggregate mixture and concrete mixture tests; (3) Co-ordination of field and laboratory measurements by actual, dry-rodded, loose-measured, and inundated volume, and by weight; (4) An algebraic method of combining any number of sizes of aggregates for uniform grading of any coarseness modulus, proportioning by size and absolute volume of particles; (5) Co-ordination of the fundamentals of the various theories of proportioning concrete mixtures; and (6) Establishment of constant technological control as a daily routine of the concrete manufacture. These are comprehensive subjects and only a general outline of the aggregate testing and aggregate and concrete proportioning methods will be given.

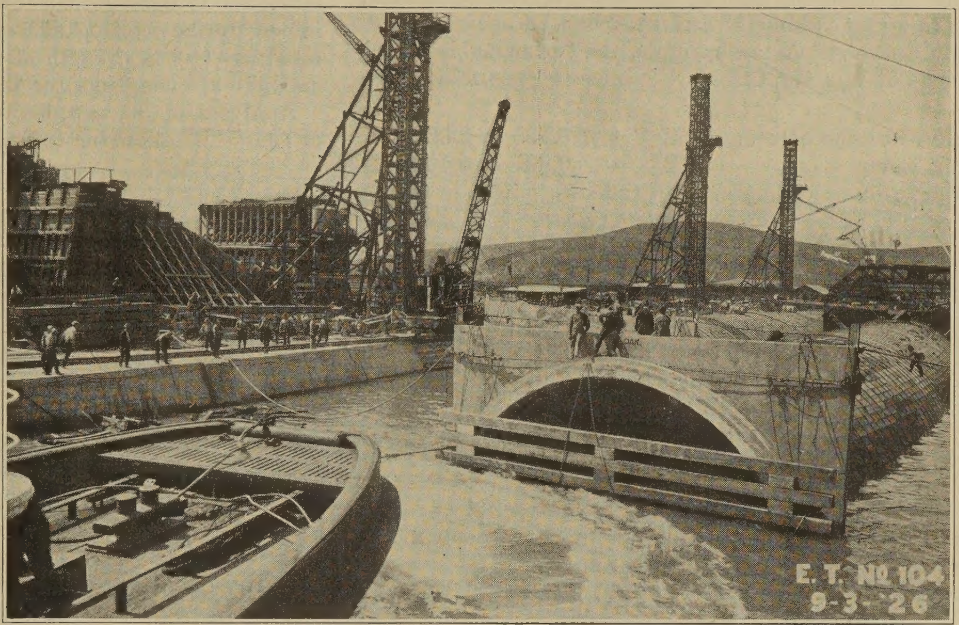
A concrete laboratory was maintained at Hunters' Point. Preliminary research tests were made of the aggregates and of aggregate, mortar and concrete mixtures varying the grading, fineness modulus and consistency for two cement contents (1.5 and 2.0 bbls.) to determine the strength, density, water-cement ratio, weight, cement-space ratio, filler-voids relations, etc. One man-hour of advanced laboratory control was maintained for every 10 cu. yds. Routine tests, of aggregates as received, were made to determine specific gravity, density, fineness modulus, grading, moisture, bulking, absorption, and content of silt, organic matter and inferior particles. Calculation and readjustment of proportions of aggregates and water were made as required by natural variations in the grading, density, moisture, absorption, and bulking of the individual aggregates as received. A laboratory duplication was made of each change of proportions to check the physical characteristics expected for that grading, cement and water content. Routine slump, wash, and compression tests were made for each pour.

Aggregate Test Methods

The new features of the procedure of testing aggregates are the "weight-volumetric" method of measurement, the regular use of a full container, and the co-ordination of measurements. The procedure is as follows:

	Measurement	***Weight-Volumetric Measurement***
(a)	Weight water filling container	(1)
(b)	Weigh loose-moist aggregate filling container	(2)
(c)	Dry (b) and weigh	(3)
(c_1)	Make standard sieve analysis	
(c_2)	Make standard silt test	
(c_3)	Make standard organic matter test	
(d)	Weigh dry-rodded aggregate filling container	(4)
(e)	Weigh (d) inundated	(5)
(e_1)	Allow (e) to stand three hours, drain, blot and weigh	(6)
(f)	Apparent density of dry-rodded aggregate	$= \frac{a - e + d}{a}$
(g)	Apparent specific gravity of aggregate particles	$= \frac{d}{fa}$
(h)	Apparent density of loose-moist aggregate	$= \frac{cf}{d}$
(i)	Weight of moisture to weight of dry aggregate	$= \frac{b - c}{c}$
(j)	Bulking of dry-rodded volume by moisture and loose measurement	$= \frac{d}{c}$
(k)	Volume of moisture to dry-rodded volume	$= \frac{d(b - c)}{ca}$
(l)	Relation of proportion of moisture by volume of dry-rodded aggregate to proportion by weight in the corresponding loose-moist aggregate	$= k/i = a/d$
(m)	Weight of dry-rodded aggregate per cubic foot	$= 62.4\, g\, f$
(o)	Weight of water absorbed to weight of dry aggregate used	$= (e_1 - d)/d$
(o′)	Volume of water absorbed by apparent volume of aggregate	$= g(e_1 - d)/d$

The (a) measurement provides a check for the standard container and also makes it possible to use a bucket or other suitable vessel of unknown volume in case of need.



Shows two segments, with ends bulkheaded, afloat and ready to remove from dry dock. The outer surface of the segment is covered with a watertight membrane and this in turn covered with a protective wood sheeting 3 in. thick held in place by hoops of ½-in. rods. Concrete plant and towers are shown at left of dry dock

Results of Aggregate Tests

A fine and coarse sand were tested by us at the dealer's before each delivery, and premixed by him in proportions determined from these tests. Two sizes of rock were premixed in the same manner. The materials varied somewhat in physical character with each delivery. Typical physical characteristics of the sand and rock, as received at Hunters' Point, were as follows:

	Sand	Rock
Apparent density (dry-rodded)	0.663	0.576
Apparent specific gravity	2.654	2.695
Moisture (by absolute volume)	0.136	0.014
Absorption (by absolute volume)	0.04	0.025
Bulking of dry-rodded volume	1.245	1.069
Fineness modulus	3.136	7.31
Discolored rock	----	0.094
Inferior rock	----	0.014

Typical gradings of the aggregates as received are as follows:

	Per Cent Retained	
Sieve No.	Sand	Rock
100	97.9	100.0
48	82.6	99.9
28	54.7	99.8
14	43.2	99.6
8	29.2	99.5
4	6.0	97.6
⅜-in.	0.0	86.0
¾-in.	----	47.6
1½-in.	----	0.0
Fineness modulus	3.14	7.30

New Method of Grading Aggregates

An algebraic method of grading three or more sizes of aggregates for practical uniformity of any fineness modulus, as used on this work, should be of considerable interest to those familiar with the graphical cut and dried method of determining proportions for uniform grading as developed by William Barnard Fuller, M. Am. Soc. C. E. (See "The Laws of Proportioning Concrete," p. 67, Vol. LIX Transactions, Am. Soc. C. E.)

The new method used on this work combines the fineness modulus principle with the grading equation, $r = 1 - (d/D)^n$, in which (r) is the proportion by absolute volume retained by a given screen opening of (d) inches, (D) is the maximum size of aggregate and (n) is an exponent. A grading of any desired fineness modulus is possible by controlling the value of (n). The practical values of (n) vary from 0.45 to 0.60, increasing with the cement content and fineness modulus. When (n) is 0.5 the curve is a parabola corresponding to Fuller's theoretical grading. From this curve he deducted a weight of sand equal to the weight of cement used, thus increasing the fineness modulus with the cement content but losing a measure of uniformity.

The writer's method is to select the maximum desirable fineness modulus for the condition of character of aggregate, cement content and workability, and find the corresponding value of (n).

The desirable fineness modulus for Class "A" concrete was found in the preliminary tests to be 6.00. The grading equation for F. M. = 5.99, $D = 1\frac{1}{2}$-in., is $r = 1 - (d/1.5)^{.56}$, and the grading is as follows:

	Proportions Retained	
	Mixed Aggregate	Sand
Sieve No.	r	$(r - r')/(1 - r')$
100	.9550	.8556
50	.9340	.7882
30	.9032	.6893
16	.8564	.5392
8	.7884	.3209
(4) $r' =$	.6884	.0000
⅜-in.	.5399	----
¾-in.	.3217	----
1½-in.	.0000	----
Fineness modulus	5.99	3.19

r' is the proportion of coarse aggregate. The fineness modulus of the coarse aggregate is determined by proportion to be $\frac{5.99 - 3.19\,(1 - r')}{r'} = 7.25$.

The fine and the coarse aggregates were accordingly premixed for the ideal fineness moduli of 3.19 and 7.25, respectively, the dealer accomplishing this generally with satisfactory accuracy.

New Basis of Concrete Proportioning

A uniform grading of particles by diameters and absolute volumes with an absolute volume of cement to a unit volume of concrete and an absolute volume of mixing water to a unit volume of cement, was used as an absolute basis of mixture. As an example, the following is a typical basis of mix for Class "A" concrete (assuming 1 cu. yd.):

Absolute volume of cement $2 \times 4 \times 0.485 = 3.88$ cu. ft.
Mixing water $2 \times 4 \times 0.80 = 6.40$ cu. ft.
Absolute volume of aggregate (graded to $r =$

$$1 - (d/1.5)^{.56} = \underset{\text{(yield)}}{\frac{27}{0.97}} - \overset{\text{(cmt.)}}{3.58} - \overset{\text{(wtr.)}}{6.40} = 17.56 \text{ cu. ft.}$$

With aggregates as given preceding (a hypothetical case), the absolute volumes of fine and coarse aggregates are determined from the fineness moduli and the total volume of aggregates as follows:

$$17.56\,\frac{(7.3 - 5.99)}{(7.3 - 3.14)} = 5.53 \text{ cu. ft. sand and}$$

$$17.56 - 5.53 = 12.03 \text{ cu. ft. rock.}$$

The mixing water, correcting for moisture content and absorption of the individual aggregates, is

$$6.40 - 5.53(0.136 - 0.04) - 12.03(0.014 - 0.025) = 6.00 \text{ cu. ft.}$$

The proportions, measuring aggregates by loose-moist volume, are:

	Loose Volume
Cement	2 bbls.
Added water	6.00 cu. ft.
Sand (5.53/0.663) 1.245	10.4 cu. ft.
Rock (12.03/0.576) 1.069	22.3 cu. ft.

It should be kept in mind that these calculated proportions are correct only as long as the characteristics of the aggregates remain as given and that about one man-hour of highly efficient laboratory control for every 10 cu. yds. is necessary to keep up with the natural variation of the aggregates.

The characteristics of the usual Class "A" and Class "B" mixes were as follows:

	Class "A"	Class "B"
Fineness modulus	5.9 to 6.1	5.8 to 6.0
Grading, *n*	0.54 to 0.58	0.52 to 0.56
Bbls. cement per cu. yd.	2.00	1.50
Water-cement ratio	0.80 to 0.84	0.90 to 0.94
"Real Mix," sacks cement to cu. ft. of dry-rodded mixed aggregate	1:3.07	1:4.32
Density	0.83 to 0.87	0.82 to 0.86

Usual proportions for 1 cu. yd.:

Cement, sacks	8	6
Sand, loose-moist	11.4	12.7
Rock, loose-moist	21.8	23.1
Celite, by weight of cement, per cent	1	2

Compression Tests

One or more samples of 4 to 6 compression specimens was taken of each pour. Where six specimens were taken, two were turned over to the contractor for independent testing. The specimens were tested at 2, 3, 7 and 28 days and some at other ages. In view of the erratic nature of compression tests and the law of probability and error in measurement, the probable strength of the samples was determined by taking the average of the following three determinations:

(1) The 28-day strength as measured;

(2) The 28-day strength indicated by the 7-day strength in accordance with the U. S. Bureau of Standards formula, $S_{28} = S_7 + X\sqrt{S_7}$, ($X$ having been determined as 27.7); and,

(3) The 28-day strength as indicated by any two strengths at ages greater or less than 28 days as determined by the semilog age rate formula, $S = k \log a + c$, in which (S) is strength at any age (a) in days and (k) and (c) are constants for the particular sample.

Analyses of 50 samples of Class "A" and 23 samples of Class "B" show the following results:

COMPRESSIVE STRENGTH AT 28 DAYS
(Lbs. per Sq. In.)

	Class "A"	Class "B"
Minimum	2965	1980
Average	3715	2725
Maximum	4415	3390
90 per cent between	3240 and 4415	2240 and 3390
75 per cent between	3445 and 4415	2460 and 3390
50 per cent between	3775 and 4415	2670 and 3390
25 per cent between	3965 and 4415	2950 and 3390
10 per cent between	4200 and 4415	3130 and 3390

Assuming that the lower 10 per cent of samples are due to the usual adverse errors of compressive tests, the minimum indicated strengths at any age, in any part of the concrete, based on the highest of the lower 10 per cent, are expressed by the following equations:

Class "A" $S = 2074 \log a + 248$
Class "B" $S = 1794 \log a - 356$

This indicates that the probable minimum strength of the concrete in the shell, at age of 100 days, is about 4400 lbs. per sq. in. and that in the roadway slab is about 3200 lbs. per sq. in.

Workmanship

The workmanship has proven better than anticipated and the tube was made watertight with an unusually small amount of grouting. Some difficulty was experienced with Segment L, the first segment poured, and about 3 per cent of honeycomb occurred in both the invert and crown. This was due to stiffness of the plant, newness of the operations to all concerned, and to a number of details of plant setup, forms, reinforcement, organization, etc., which were soon corrected. This segment had ties on 18-in. centers both ways between the outer and inner layers of reinforcing so that men could not work inside. In subsequent segments these ties were changed to 4-ft. centers so that men could be placed inside to puddle the concrete. The defective portions were cut out and patched with gunite and subsequent defects, which were of minor character and few in number, were either gunited or grouted.

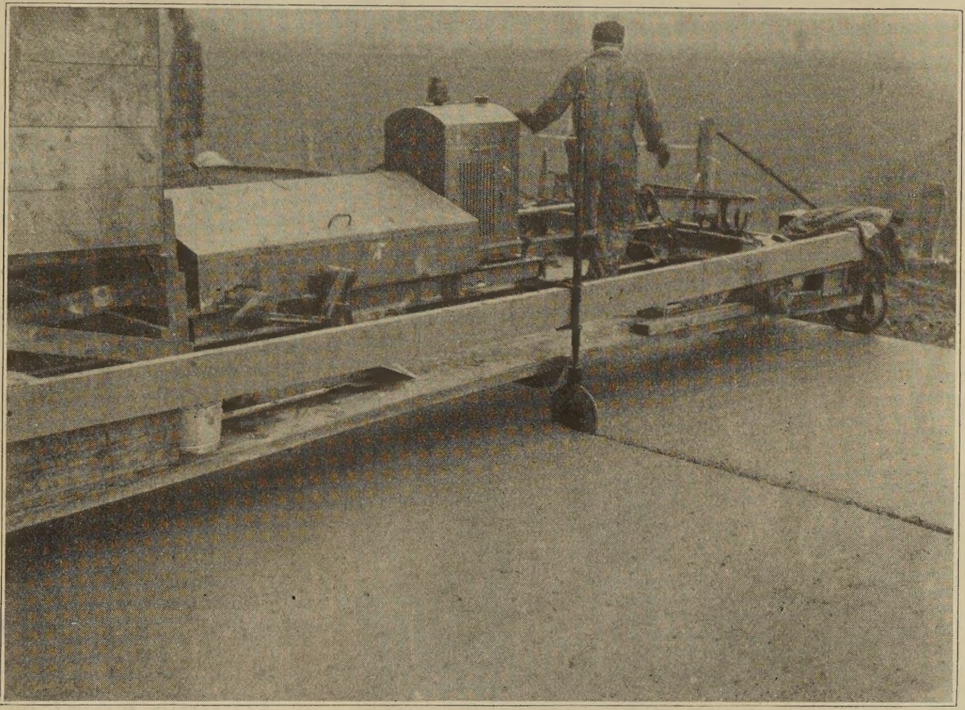
Alameda County personnel concerned with the concrete production were George A. Posey, chief engineer; Charles Derleth, Jr., consulting engineer; Lochiel M. King, construction engineer; Joseph A. Kitts, concrete technologist; Richard Barry, and George Wright, assistant concrete technologists, and H. S. MacManaman, concrete inspector.

The California Bridge and Tunnel Company, San Francisco, were the contractors: A. J. Crocker, president; Harry Lesser, secretary-treasurer; Francis Betts Smith, consulting engineer; A. A. Horwege, superintendent.

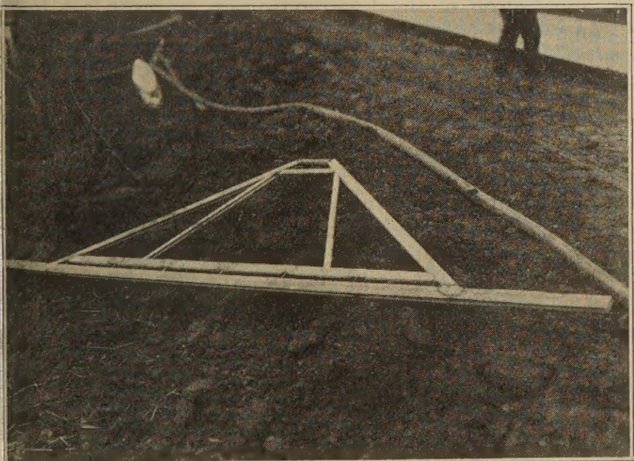
Iowa Experiments with Dummy Longitudinal Joint

Money-Saving Method of Constructing Weakened Plane Longitudinal Joint Developed in Iowa

THE weakened plane or "dummy" joint has been used for several years by paving engineers. It is especially popular on the Pacific Coast, but has been used to some extent in nearly every state. The Iowa Highway Department has developed construction methods which promise to reduce the cost of the longitudinal dummy joint to a minimum, and at the same time assure a good looking job.



The cutting wheel, on the back of the finishing machine, cuts a slot 2½-inches deep and about ½-inch wide in the center of the slab



The filler is installed in the slot by means of a sheet metal frame which assures a straight center line

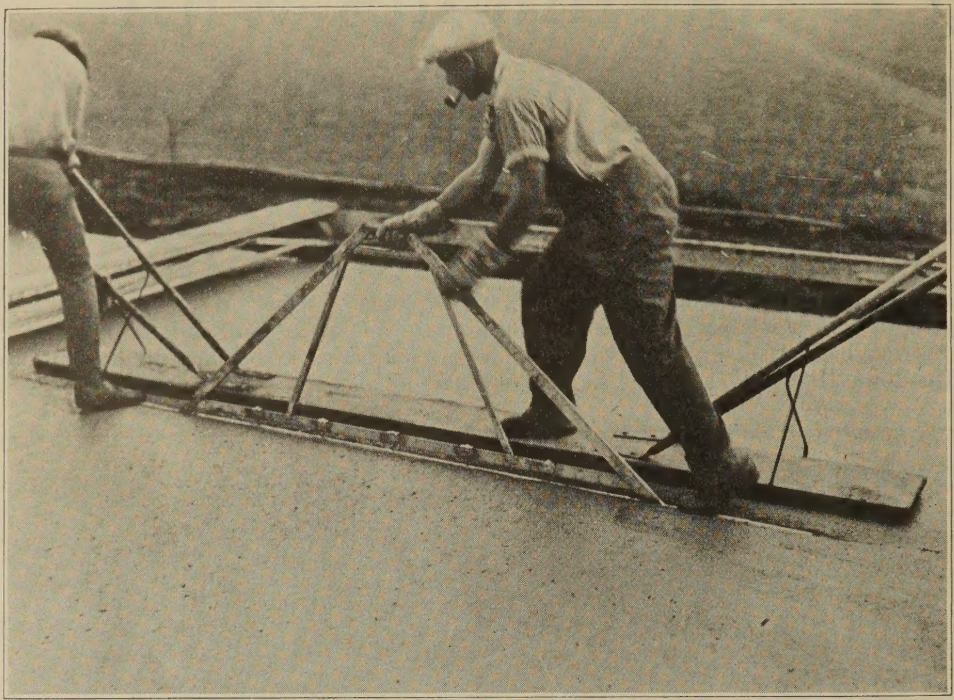
The weakened plane is made by cutting a slot about 2½ in. deep and from ¼ to ½ in. wide in the surface of the slab. When contraction or bending of the slab occur, the concrete beneath this slot cracks, forming a joint for the full depth of the slab and eliminating longitudinal cracking. Just how much transfer of load can be expected across this longitudinal joint has not yet been determined.

Cutting the Slot

In Iowa, the slot is cut by a wheel attached to the back of the mechanical finishing machine. The slot is then immediately filled with a strip of bituminous joint filler 2½ in. wide, ⅜ in. thick and 10 ft. long.

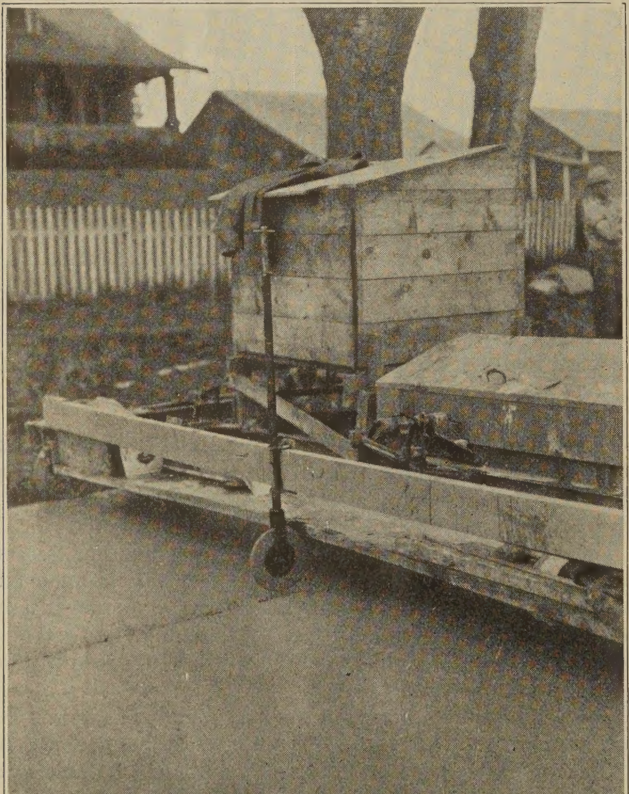
The slot is cut when the finishing machine makes its final passage over the slab. The cutting wheel is attached to a rod on the back of the finisher. The rod can be lifted, to raise the wheel above the concrete during the first operations of the machine. It is held in the lifted and in the cutting positions by a key.

The joint filler is placed in a sheet metal holder and is then pushed into the slot. The holder is a channel, which is the container for the filler, a handle which makes it possible to push the filler into the slot while the operator stands erect, and a device which ejects the filler from the channel. This latter consists of ¼-in. rods which go through holes in the web of the channel. They are fastened to a bar, running parallel to the channel, which is,



The channel holding the filler is pushed into the slot. The filler is then forced from the channel by rods attached to the steel members which connect to the lower of the two horizontal handles

in turn, attached by metal sections to a handle, which is pushed down when it is desired to force the filler from the channel. The filler is first inserted in the channel, channel and filler are forced into the slot by two men, the filler is forced out and the device is removed. Final finishing of the surface with longitudinal float, long handled float and belt follow the installation of the joint filler. No transverse joints are put in at present, though they will probably be used in Iowa in 1930.



The cutting wheel is raised above the slab during the first passages of the finishing machine

Low Cost

The cost of the joint filler is about the whole cost of the dummy longitudinal joint, as installed in Iowa, because the cutting wheel is set by the finishing machine operator, at no additional cost, and the filler is installed by the two finishers who operate the longitudinal float, so no additional labor is required.

Unique Road-Making Experiment By Australians

A unique road-making experiment has just been made in Parkes, New South Wales, Australia, in the form of a twin-track concrete road. The National Roads and Motorists' Association of the Commonwealth believes this form of concrete construction will eventually prove to be the solution of the road-making difficulties in the country districts of Australia.

Two strips of concrete, each a foot wide, and adequate to carry all forms of wheeled traffic, were laid down by a farmer at his own expense, and the road, after an 18 months' test under normal traffic, is almost as good as new. Local people regard this form of road as eminently satisfactory. The concrete was mixed from the gravel formation of the old road, and thus the cost was remarkably small, working out at no more than £560 ($2,800) per mile.

Beyond a slight breaking away at the edges, due to amateurish methods, the concrete is as firm as it should be. The N. R. M. A. urges that, in view of this success, further experiments in the different country districts of New South Wales should be made by the Main Roads Board. Naturally, this form of road is only suitable in localities serving a limited amount of traffic.

Products Plant Costs

Some Timely Thoughts on the Subject of Products Plant Administration from the Standpoint of Manufacturing Costs

By W. D. M. ALLAN
Manager, Cement Products Bureau, Portland Cement Association

PERSONAL contact with leading concrete products manufacturers from Omaha east during the last few months indicates that, with the exception of a few bright pots, there is a temporary lull in the production and sales of concrete masonry. A decrease in demand for other building materials is also noticeable. In spite of the lull n the concrete products field, there is a decided feeling of optimism among the leaders who are employing additional salesmen and putting forth greater sales effort than ver before, as well as using an increased amount of direct mail and local newspaper and magazine advertising. This endency to meet decreased demand with increased sales ctivity shows that the concrete products industry is on very sound merchandising basis.

Overcapacity

The temporary lull has emphasized the large overapacity in products plants. Leading manufacturers have ealized for some time that there is enough concrete prodcts capacity in the United States to supply the total emand for not only all concrete masonry but all common lay brick and clay tile as well. In terms of 8- by 8- by 6-in. units, the total demand for common masonry in the United States amounts to approximately 1,250,000,-00 units; of this amount 384,000,000 units are concrete nd the remainder clay. Concrete products plants are perating at less than 15 per cent capacity. If operated t 60 per cent capacity, more than 1,250,000,000 (8- by 8-y 16-in.) units would be produced. As long as sales olume was up, the concrete products plants made money nd the seriousness of over-capacity was not felt. As soon s sales fell off, however, the largest capacity plants were either just breaking even or, for a few months, ctually running in the red. This condition had led many f the larger manufacturers to study sales and manufacturing costs more carefully than they ever have before and the best thought of the concrete products industry at resent is being given to the solution of the problem, What is the most efficient size of plant?"

Fixed Capital

In one mid-western city this study revealed that a plant with $17,000 fixed capital, exclusive of land, did a business in 1928 of 800,000 block. Another plant in the same market, with a capital investment of over $100,000, did business of only 500,000 units. A study in other markets shows that the capital investment, exclusive of land, varies all the way from $25 to $200 per thousand units produced annually. This represents a fixed charge of ¼ to 2 cents per block produced. In other words, the plant with the high fixed capital charge pays eight times as much per block as the smaller plant. In some cases is the difference between $2.50 per thousand and $20.00 er thousand.

A study of cost sheets in many of these plants showed no marked difference in labor cost, showing that large investment in plant and equipment is no indication of low labor cost. Labor costs in both small and large capacity plants varied from 1¾ to 2¼ cents per block placed in the yard. The tendency is toward a higher labor cost in the plant with the higher fixed capital charge, and this is explained on the basis that there is likely to be more unproductive or semi-productive labor in such a plant.

The following case shows how the temporary lull in production has served to drive home the effect of high fixed capital on the cost of block. A plant with $200,000 invested in building and equipment produced 1,000,000 block in 1928. As long as the output was 1,000,000 block a year, the fixed interest charge from plant and equipment per block was 2 cents. During the temporary slump of the past three months, the output has been reduced to an average of 400,000 block per year, which raised the fixed charge per block to 5 cents. The plant was able to absorb a 2 cent fixed charge under normal operating conditions, even though it were eight times as high as a competitive plant, but when the production fell to 400,000 the fixed charge of 5 cents forced the plant to close because this handicap raised the price of the block above that of competitive materials of other kinds.

Effect on Profits

Ten years ago, when the average plant produced less than 20,000 units and cost less than $1,000, it could be closed down in case of a slump and the loss was not noticed because we were dealing in very small quantities. However, the business has increased, both from the standpoint of equipment and sales, two or three hundred times. Orders for 100,000 block are now quite common. Every concrete products salesman knows that a difference in selling price of $5.00 per thousand units frequently represents the difference between success and failure in landing the order. Consequently, a plant with a fixed capital charge per thousand units of $50.00 is practically out of the running on a competitive basis with a plant having less than $10.00 per thousand units fixed capital charge. The difference in the interest charge at 10 per cent on plant and equipment between the large and small plant is usually more than the net profit in the business.

A fundamental law applicable to all business has been firmly established during the last few months in the concrete products industry, namely: Efficient plants must have fixed capital charges reduced to a minimum in order to withstand severe competition.

Wear Your Machinery Out

When the pendulum began to swing away from the backyard plant in 1919, it continued to the other extreme until early in 1929. During this 10-year period, larger and larger plants were built each year with a corresponding decrease in the percentage of total time operated and, in turn, corresponding increase in the fixed charge per block. In spite of the fact that the total number of plants has decreased approximately 40 per cent in the last 10 years and sales have increased 700 per cent, total plant capacity has increased much more rapidly.

In the plants built during this period, machinery rarely ever has been worn out; it became obsolete long before it produced its full quota of block. Rusting during idleness also took its toll. The machine was either replaced by a modern one before it was amortized, thus adding to the capital charge, or it was operated at a lower capacity with increased labor cost, when a new machine would have been better. Every block machine or mixer with proper mechanical attention will produce a given number of block and in general the quicker that number is produced the more money will be made for the owner.

The pendulum is swinging back to a neutral position and leading manufacturers plan smaller plants, cut to the bone, where the fixed capital charge for the plant and equipment will be smaller but where the equipment will be used a greater part of the time. Plants will be laid out so that as soon as one machine operating at full capacity will not supply the total demand another machine can be set side by side by putting on a small addition to the building and adding sufficient curing space. Tearing down the entire plant when it is necessary to add a new machine will be a thing of the past. Concrete products plant design is very simple, because the manufacturing operation is not complicated. Consequently, it is an easy matter to lay out a plant so that it can be added to easily without interfering with present producing equipment and without providing building and curing space necessary to take care of the demand for the next 20 years. This is an inherent advantage in the concrete products business and one that must be taken advantage of if the position of concrete products is to be sound in relation to other masonry materials.

Multiple Shift Operation

The financial man is going to have more to say about equipping the plant in the future than he has had in the past. The manufacturer will take pride in getting maximum output from the minimum plant investment consistent with economical production. That this is not theory is borne out by the number of manufacturers getting large output from small plants and small capital investment who are operating their equipment 16, 18 or 24 hours a day where necessary and who have applied the piece work system to both night and day shifts, so that labor cost is practically the same regardless of what shift during the 24 hours the products are manufactured.

During the next few years, we may have to change our ideas of what constitutes a big plant. Size of building, investment and number of machines have been standard since the backyard era, but in the modern merchandising era, which is well on its way, the big plant in the true sense of the word will be measured in terms of strong merchandising organizations, plus a manufacturing unit with the maximum fixed cost, operating 50, 60 or 70 per cent capacity.

To successfully pass through the re-adjustment period, the large plants whose fixed capitals are already established and who cannot afford to write off parts of their plant and equipment, must double or triple their sales effort to keep their volume up and reduce their fixed charges per unit.

Effect of Early 1929 Decrease in Contracts Seen in Job Volume

While activity on construction operations was 9 per cent greater in June than in May this year, a statistical study just completed by the Associated General Contractors of America reveals that the decrease in the volume of contracts awarded earlier in the year was beginning to show in slightly lessened job performance.

This decrease in activities is shown by comparison with June of last year, the decline being 5.3 per cent. June activities normally show a considerable increase over those of May, it is stated, so that the anticipated increase this year is indicative only insofar as it failed to come up to the amount shown in June last year.

Practically all the decline in contract awards is found in residential construction, notably in apartment house building, which has been hit through catching up with the demand and because of the vagaries of the financial market.

It was pointed out that the statistics of the F. W. Dodge Corporation show a decline of $404,000,000 in residential and apartment contract awards this year as compared with last. All other types of construction are shown to be near normal. This is seen as an indication of the passing of the boom speculative building market and a return to the sounder investment building which prevailed before the post war boom.

Among other factors that are conceived to have affected speculative building in the residential field is the movement toward the curbing of loose credit in the construction industry. This movement has been making considerable headway through the support of the Associated General Contractors, national organization of subcontractors and material men. Because standard credit terms are being set up in scores of cities it is said that speculative builders cannot so readily promote projects on the easy credit formerly secured from contractors and material houses.

More Uniform Building Code Requirements

Returns from inquiries to building inspectors and other local officials have developed the information that more than two hundred cities and towns have utilized the recommendations of the Department of Commerce Building Code Committee in whole or in part. This represents approximately one-quarter of all the building codes in effect.

Such codes do not ordinarily undergo major revisions at intervals of less than five years on the average and the introduction of the committee's recommendations is necessarily affected by this condition. The growing acceptance of the recommendations, however, demonstrates that variations in building code requirements throughout the country are being steadily reduced.

International Concrete Gathering to Be Held in Belgium in 1930

The first International Convention of Reinforced Concrete and Cement will be held at Liege, Belgium, in connection with the exposition to be held there in commemoration of the centenary of Belgian independence next year. The convention will be in session from August 25th to the 30th and will be devoted principally to discussion of technical questions involved in the use of concrete as a building material. English, French and German will be the languages used in the discussions.

A. S. T. M. Discusses Concrete Materials at Atlantic City

Cement, Aggregates, Admixtures, Testing Methods and Specifications Receive Attention at the Thirty-Second Annual Meeting of the American Society for Testing Materials

THERE was much of interest to concretors in the papers and reports presented at the thirty-second annual meeting of the American Society for Testing Materials, held at Atlantic City, June 24th to 28th, inclusive. Several of the sessions were devoted entirely to concrete materials and a number of important committee reports were presented.

Report of Cement Committee

Probably the most important event of the meeting, so far as concretors are concerned, was the action taken by Committee C-1 on cement. Though the committee's formal report to the society covered only the report of the special committee on the cement reference laboratory and the tentative outline for test procedure for co-operative plastic mortar tests, the committee held three meetings at which the principal subject of discussion was the establishment of a specification for high early strength portland cement and the revision of the present standard specifications to include a 3-day and 7-day strength requirement in place of the present 7-day and 28-day requirements.

This phase of the committee's deliberations was only touched upon orally when P. H. Bates, the committee's chairman, presented his report before the society. Mr. Bates gave it as his opinion that the action of the committee in this regard lacked the confidence that had characterized previous meetings, and that there was a woeful lack of any crystallized idea of what such a new specification should be. That the trend was toward an upward revision of the specifications and that new provisions covering high early strength cement would be required was indicated by Mr. Bates, though he did not report the definite strength requirements that had been agreed upon in the committee meetings. Mr. Bates concluded with the suggestion that it would be well for all parties interested to get together and crystallize their ideas on this subject. The report received no discussion in the open meeting.

New Cement Specification Recommendations

A later release, prepared by the chairman of the committee, gives the details of the committee's recommendations, as follows:

"Committee C-1 also approved for submission to letter ballot of the committee and, if approved, for submission to Committee E-10 on standards, certain tentative revisions in the present standard for portland cement. The series of motions to be submitted to letter ballot include: (1) The changing of the title of the present standard so as to cover 'portland cements' instead of 'portland cement'; (2) the insertion of two sets of strength requirements in the standard, one for portland cement and the other for high early strength portland cement; (3) the making of the tensile strength requirements of the 1:3 standard mortar for portland cement 200 lbs. at 3 days and 275 lbs. at 7 days, and for high early strength portland cement 275 lbs. at 24 hours and 375 lbs. at 72 hours; (4) the making of the 28-day test optional with the purchaser and when so desired the strengths not to be lower than those obtained in the 7-day or 72-hour test (for portland cement or high early strength portland cement, respectively); and (5) placing a limit of 2.5 per cent on the sulphuric anhydride allowed in the high early strength portland cement."

These recommendations are now to be submitted to letter ballot vote of the entire membership of Committee C-1. A two-thirds affirmative vote is required. If the recommendations are approved by letter ballot, it will be necessary for the society's newly organized Committee on Standards to receive and act upon them. The proposed revisions secure official A. S. T. M. status only after the Committee on Standards approves them.

Cement Reference Laboratory

The preprinted report of Committee C-1 concerned itself first with the report on the establishment of the new cement reference laboratory already functioning at the U. S. Bureau of Standards. This laboratory is the result of activities following the report of Committee C-1, July, 1928, when the wide variation in cement tests was reported. The need for a reference laboratory for the purpose of instructing on established methods of making tests and for calibrating testing apparatus was clearly shown in that report. It is expected that the new reference laboratory will do much to reduce the "human equation" in cement testing. The new laboratory is financed jointly by the A. S. T. M. and the Bureau of Standards.

Plastic Mortar Tests

A second section of the report of Committee C-1 presented a tentative outline of test procedure for a series of co-operative plastic mortar tests. Those laboratories participating in the tests were informed that the objects of the tests were: (1) To find out whether a given laboratory, using its local aggregates of known quality, can obtain a reasonable agreement between concrete strengths and plastic mortar strengths; (2) to find out whether a definitely specified plastic mortar test of different cements with Ottawa run-of-mine sand will give reasonably concordant results in different laboratories. The report presents detailed instructions for carrying on the tests.

Concrete Aggregates

In addition to the report of Committee C-9 on Concrete and Concrete Aggregates, a number of papers, including a symposium on mineral aggregates, were placed on the program.

Committee C-9 reported a great many investigations under way and promised several complete reports on these subjects in the near future. Several minor revisions in specifications were recommended.

There were three appendices to the report—one, a digest of the report on the effect of stone dust on the properties of concrete, by A. T. Goldbeck, another on the effect of flat particles on the concrete-making properties of gravel, by Stanton Walker and C. E. Proudley; and the third on the effect of coal and lignite in sand for concrete, by P. J. Freeman.

Mr. Goldbeck's conclusions were that each 1 per cent of stone dust reduces the strength of the concrete approximately 1 per cent, but that the wearing qualities of the concrete are not lowered. Stanton Walker and C. E. Proudley reported that when the flat particles in the aggregate do not exceed 14 per cent of the total volume of the aggregate, they did not reduce the strength of the concrete. P. J. Freeman found that when ½ to 1½ per cent of coal or lignite was present in sand, the strength of the concrete was decreased as much as 20 to 50 per cent.

Road and Paving Materials

The point of interest to concretors in the report of Committee D-4 on Road and Paving Materials was the presentation of proposed new tentative specifications for portland cement concrete for pavements and pavement base. The specification is a tentative standard and was published in the report for the purpose of eliciting criticism and suggestions. It was formulated in co-operation with the American Concrete Institute, the American Association of State Highway Officials and Committee C-9 of the A. S. T. M.

Symposium on Mineral Aggregates

Two entire sessions of the meeting were devoted to a symposium on mineral aggregates. R. W. Crum, director of the Highway Research Board, acted as chairman and opened the symposium with a discussion on inspection of aggregates for use in concrete highway construction. He pointed out some of the many difficulties of fair inspection and urged the employment of trained men capable of taking full responsibility in testing. The need of giving the producer a fair deal was also emphasized.

Another paper on the subject of aggregate inspection by A. S. Rea of the Ohio Department of Highways, followed. Mr. Rea spoke of the important part played by aggregates in concrete construction and urged careful inspection. He pointed out that approximately 90 per cent of the aggregate used is inspected at destination and compared inspection methods at the source and at destination.

Fine Aggregate

Two papers dealing with the subject of fine aggregate were presented—one by H. F. Gonnerman of the Portland Cement Association; the other by J. C. Pearson of the Lehigh Portland Cement Co.

Mr. Gonnerman's subject was "Fine Aggregate in Concrete." In a 20-page preprint he reviewed the present knowledge on the subject of sand as a fine aggregate. Such subjects as workability, uniformity, size, shape, surface characteristics and grading were discussed.

"Fine Aggregate in Mortar and Plaster," was the subject of Mr. Pearson's paper. The reason for the lack of attention to the quality of fine aggregate for mortar or plaster is the relatively minor part that it plays in the properties of the plaster. He concludes that "almost any materials worthy of the name of fine aggregate can be used satisfactorily as aggregate for ordinary mortar and plaster; but some, of course, are better than others."

Coarse Aggregates

The three principal conclusions made by F. C. Lang of the Minnesota Highway Department, in his paper on the "Influence of Quality of Coarse Aggregate on the Strength of Concrete," are:

(1) Coarse aggregate deficient in structural strength as shown by the abrasion test has more effect on the transverse and tensile strength of concrete than on the compressive strength.

(2) The absorption in itself has no effect on the strength of the concrete when the effective water-cement ratio is correctly used.

(3) There are not enough data to warrant any conclusions as to the effect of shape and surface texture.

These conclusions on the effect of abrasion loss were confirmed by tests cited by F. H. Jackson of the Bureau of Public Roads, but A. T. Goldbeck said that he had found that abrasion resistance did have some effect on strength.

Geological characteristics of coarse aggregate and their effect on the durability of concrete were discussed in a paper by F. R. McMillan and G. W. Ward of the Portland Cement Association. Texture, structure and impurities that cause rock failure were considered and points that should be guarded against in the selection of aggregate were pointed out.

In his paper, "Influence of Mineral Composition of Aggregate on Fire Resistance of Concrete," S. H. Inberg of the U. S. Bureau of Standards, listed the types of aggregates in the order of their desirability as: (1) Calcareous, (2) feldspathic, (3) granites and sandstones, and (4) siliceous aggregates. He said that the mineral composition of the coarse aggregates has a greater influence on the fire-resistive properties than that of the fine aggregate because of the greater amount of coarse aggregate used in the mix.

Needed Research

In concluding the symposium, F. H. Jackson (U. S. Bureau of Public Roads) listed the following as among the more important aggregate problems in need of solution:

(1) Relation between character of aggregate and flexural strength of concrete.
(2) Relation between character of aggregate and durability of concrete.
(3) Standardization of laboratory tests for durability of aggregates.
(4) Standardization of laboratory tests to indicate directly the quality of aggregates for concrete.

Research in Cement and Concrete

In a paper presented by O. L. Moore, engineer of tests for the Universal Portland Cement Co., a new method of making compression tests for portland cement was described. The author said that the method "offers a good criterion for the portland cement strength in concrete. It utilizes a consistency which is subject to minimum error in mixing and molding, and it has interesting possibilities for standardization because of the uniform properties of standard sand."

Data are presented which show that 2-in. mortar cubes made with standard Ottawa sand and 0.8 water ratio, give the same strengths at the same ages as 3- by 6-in. cylinders of concrete made with a water ratio of 1.0. The difference in water content is considered to be due to the larger voids in Ottawa sand. There was some discussion, revolving principally around the use of Ottawa sand.

Herbert J. Gilkey, who had presented a paper on the same subject at a 1926 meeting of the society, again discussed the subject of autogenous healing of portland cement mixtures. Tests were made with broken briquettes, the parts of which were tied together with rubber bands. It was found that when these specimens were placed in water they would knit together so strongly that they would develop measurable strengths. One briquette that originally broke at 248 lbs. at 3 days, showed a recovery in strength of 221 lbs. in 3.5 months.

N. H. Roy (University of Illinois) reported a simple fermentation test by means of which the presence of sugar in sand could easily be determined.

R. E. Davis and G. E. Troxell of the University of California, reported long-time laboratory tests made on plain concrete cylinders to determine the axial and lateral deformations produced by axial compressive stresses. The relation between the lateral and axial strains was given by values of Poisson's ratio. They found that Poisson's ratio increases with age, but at a gradually decreasing rate; that it does not vary materially with either the richness of the mix or the character of the aggregate and that it is greater for low stresses than for high ones.

Powdered Admixtures

The opening gun in what promises to be a battle royal on the subject of admixtures was fired when Duff Abrams, research director for the International Cement Corporation, presented his paper on "Tests of Powdered Admixtures in Concrete." Tests were made using 14 admixtures and using both nominal portland cement and high early strength portland cement.

As a result of the tests, Prof. Abrams drew the following conclusions:

"The workability of the concrete as measured by the flow test was not improved by any of the 14 powdered admixtures tested.

"The excess water required to produce same workability as similar concrete without admixture was approximately proportional to the normal consistency of the admixture as measured by the Vicat needle.

"All of the commercial admixtures tested must be classed as injurious adulterants, due to excess water required to maintain workability. The reduction in concrete strength was proportional to the excess water.

"The colloidal clays of the Bentonite type were most injurious on account of large excess water required as reflected by their high normal consistencies. Loss in strength ranged from about 1.5 per cent to 5 per cent for each 1 per cent of admixture in terms of weight of cement.

"After colloidal clays, diatomaceous earth was the most injurious to strength and workability, although the serious loss in strength was confined to early ages.

"The slightly hydraulic admixtures, powdered slag (high calcium granulated), precipitator dust, and one artificial admixture showed slight increases in strength at early ages, but this benefit was doubtful after ages of 7 days.

"In general, loss in strength due to admixtures was greater at ages of 1 to 3 days than at ages of 7 days to 3 months."

New Bridge for Adelaide Is Widest Concrete Span

Adelaide City Council, Australia, has approved of a design for a reinforced concrete bridge to replace the present city bridge. It is estimated that the bridge will cost £79,000 ($395,000). The new bridge will replace a structure dating from 1877.

It is to be entirely of reinforced concrete, and is to consist of a main span over the river, and two approach spans, one on each side. The main span is to be constructed of ten three-hinged arch ribs, giving a clear span 3 ft. above water level of 115 ft. 6 in., and the approach spans will each consist of ten arch ribs of the bowstring type, having a clear span of 31 ft. 6 in. The hinges for the main arch ribs are to be of cast steel. The bridge will be 132 ft. wide between inside faces of handrails, while the total length of the new structure will be 221 ft. 4 in. The width of each footpath will be 20 ft., and that of the roadway 92 ft. between curbs. The total increase in width of the bridge is 77 ft. 6 in., or about 2½ times as wide as the present structure. The balustrade will consist of concrete posts and handrails, and the balustrade panels are to be of bronze.

To allow free movement of the main arch ribs at the three hinges, the decking of the bridge has been broken for the full width of the bridge on a line vertically above the line of the hinges in the arch ribs. This means that there are three expansion joints; one located over the center of the main span, and one approximately over the river face of each abutment. These joints allow free movement of the decking, due to movements of the arch ribs, and at the same time provision is made in the form of plastic joints for a continuous surface for the traffic over the bridge. On the line of each handrail, two pylons and two pilasters, with refuges, are to be constructed, the pylon being at the ends of the bridge, and the pilasters between the approach and the main arches. The main abutments are to be of mass concrete, and each is supported on 39 bents of ironbark piles of six piles per bent. This decision was made after much preliminary work at the site, and many different design investigations.

To ascertain the nature of the foundation at the bridge site, shafts were sunk and four bores were drilled, and samples taken of the different classes of material at different depths, one bore being drilled at each corner of the present bridge. The type of material encountered in each bore varied owing to there having been a considerable amount of filling at the time of the present bridge's construction. Generally the material varied to a depth about 4 ft. below water level, below which for 20 to 25 ft. was sand and gravel, at which depth a band of yellow clay 2 to 5 ft. thick existed, and then sand and gravel again. The results of this boring indicated that no solid rock could be counted on for foundations, so that the loads of the new bridge would have to be transmitted to the ground through pile gravel. This fact also decided the type of bridge as a three-hinged arch as against a hingeless arch, as the effect of a possible settlement of the foundations, is comparatively negligible, whereas in the case of a hingeless arch a foundation settlement might lead to disaster. On account of its extreme importance, a great deal of consideration has been given to the question of the design of the foundations, and many schemes were considered before a final basis for design was adopted. In treating the foundation, each scheme had to take account of three different types of loading under different parts of the bridge, that is loading due to street car, vehicular and foot traffic, each with four different conditions of loading.

Further, the new bridge being the widest known reinforced concrete bridge in the world, and having ten ribs supporting its superstructure, necessitated special consideration being given to the abutment on account of its length, in order that it should act in uniformly distributing the various loads to the pile supports throughout its length. Accordingly, instead of a uniform section throughout, the abutment has been apportioned to give a mass distribution corresponding to that required by the forces acting on the abutment at the part concerned. The design finally adopted was one with a mass concrete abutment, supported by 39 bents of six piles per bent of ironbark piles driven at an angle of 25 degrees from the vertical.

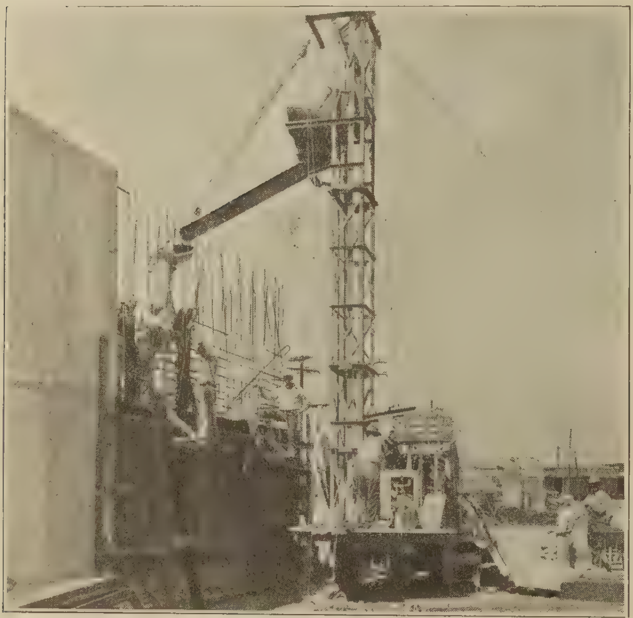
Mobile Mixing Plant
Places Concrete for
2,200 Foot Retaining Wall

Mixer and Tower Mounted on Truck Permit Placing of Concrete Directly Into Wall Forms

IN building a 20 ft. retaining wall, 2,200 ft. long, for the Rio Grande Oil Company at their Long Beach Harbor Terminal, near Los Angeles, several unusual methods were used by the Sumner Sollitt Company, contractors for the work. The wall was designed with keyed asphaltic expansion joints approximately 60 ft. apart and as it was also desired to have certain portions of the wall completed ahead of others, it was necessary that the concreting plant should be easily moved around to different positions on the site. Economical reasons made it desirable that the concrete be placed directly in the forms with the least amount of handling labor.

A Mobile Concrete Plant

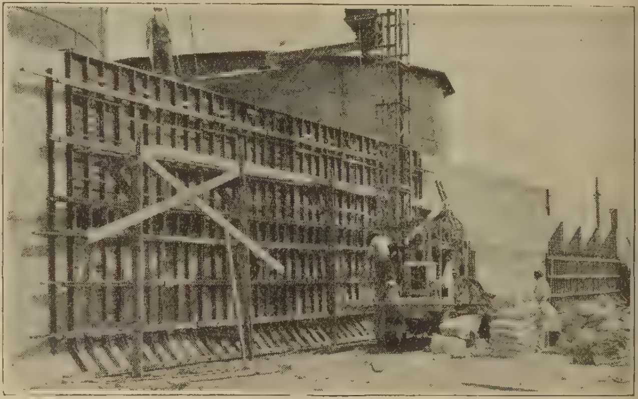
The concrete for the foundations was placed with a paving mixer, with the aggregate received in batched trucks, and the concrete deposited by the mixer directly into the foundation. The concrete for the wall was placed with a 7 ft. Bremer mixer placed on a motor truck with a steel hoisting tower, also placed on the truck so that the mixer discharged the concrete to the hoist skip, it then being hoisted and through chutes deposited directly in the forms, no wheeling or scaffold being necessary.



A portable plant consisting of a mixer and steel hoisting tower mounted on a truck placed the concrete in the wall

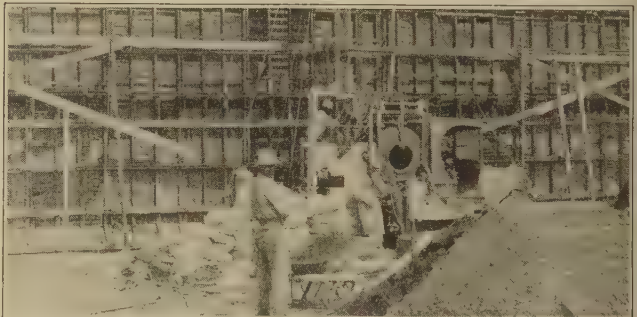
An innovation in form work was the use of corrugated iron on the wooden panels so that the face of the wall has a paneled effect, the corrugated iron slightly recessing the panels. Panel forms were used throughout, being held together at the bottom with Bosco band iron clamps and above with Willard clamps. Sufficient forms were provided so that 60 lineal ft. of wall was concreted daily.

The wall encloses approximately six acres, in which are located a number of large gasoline and oil tanks. The wall is designed to resist a pressure of about 17 ft. of oil in case an accident would let the oil from the tanks. It is 2 ft. 8 in. thick at the bottom and 8 in. at the top, has a foundation 12 ft. 8 in. wide and has counterforts 15 ft. on centers on the back of the wall. The proportions of aggregate and cement were determined by the Osborne Testing Laboratories. Three per cent of Calatom admixture was used throughout.



Corrugated iron, placed on the wooden form panels gave the face of the wall an unusual panel effect

The work was performed under the direction of J. J. Downey, chief engineer of the Rio Grande Oil Co., W. C. Farquhar being directly in charge of the work, Harvey R. Field, vice-president, Sumner Sollitt Company, Los Angeles, had charge of the work for his company, H. J. Schaufele being superintendent at the job.



Concrete for the foundations was placed with a paving mixture

W. A. Bremer of Los Angeles built the mixer and assembled the combined mixing and hoisting unit.

~ EDITORIAL ~

Field vs. Laboratory

TO a greater extent than ever before, theory is becoming practical. The steadily increasing number of job laboratories in which men intimately associated with the practical end of construction apply laboratory methods to field conditions is helping to bring about a better understanding between the job and the laboratory.

This is as it should be, for is it not the ultimate purpose of laboratory investigation to improve the quality of the concrete in the structure? And are not construction methods and materials investigated with this end in view?

An example of research of this type is found in the report on measurement of materials, mixing and placing concrete, made by sub-committee XII of Committee C-9 before the recent A. S. T. M. meeting. This committee feels that specifications for the measurement of materials, mixing and placing should be based on some measurable property of the concrete as it is actually used on the job. The condition of the resulting concrete as it leaves the mixer, at the point of delivery to the forms and after it has been placed is what concerns the committee. The preliminary steps in making concrete are being studied as they affect the concrete under actual job conditions. Information of practical value to the engineer and the contractor is bound to result.

It is frequently contended that laboratory tests do not indicate the performance of a material or the value of a method under actual job conditions. It is well known that some cements that show up indifferently in laboratory tests give tests in concrete under job conditions far higher than the laboratory tests would indicate. And vice versa.

The subject of admixtures, for instance, is one that would be particularly suitable for test under actual field conditions. Size of aggregates used, proportions, water content, mixing and placing, are seldom identical in laboratory tests and field tests. Workability as measured in a laboratory may vary widely from the workability sought by the contractor and the engineer out on the job.

Since the ultimate object of all tests and experiments is to improve the quality of the concrete in the structure or to secure concrete of special characteristics for special uses, it is not unreasonable to accord special emphasis to actual job experiences.

In the highway field there are a number of instances of tests made under actual job and service conditions. A wealth of valuable information was secured from them. Is it impossible to secure similar information in other branches of the construction industry? Actual jobs provide a convenient means of experiment. The performance of structures under different service conditions yields practical information. The results of the tests made in this great laboratory of actual experience, if compiled, classified and analyzed would yield a wealth of information that would be of inestimable value to the concretor.

A New Specification for Cement

IT was inevitable that the cement committee of the American Society for Testing Materials would propose the adoption of a specification for cement that would include provisions for high early strength. No other satisfactory course was possible.

Though there seems to be some anxiety that the new provisions are not completely agreeable to all members of the committee, the important point is that definite action has been taken and the cement user may expect that either the present recommended revisions or something similar will receive official A. S. T. M. standing before very long.

The adoption of a new specification for high early strength portland cement and the revision of the present standard portland cement specification is a serious matter both for the user and for the manufacturer. It should not be done precipitately. Yet it should not be delayed an instant longer than is necessary to frame the new provisions satisfactorily.

To some observers it may have seemed that the action of the committee lacked confidence and assurance. If this is true, then a more definite and surer footing should be found immediately. Certainly the idea that some change in the specifications was needed must have been in the minds of the committee members for some time. For several years the need has been plainly evident. There was ample time to crystallize opinion.

The final action of the committee must be based on the answers to these two questions: Will the new specification meet the needs of the user more adequately, and is it practical from a manufacturing standpoint? If the answers are affirmative, the proposed specification should be approved.

Products Plant Costs

THERE is much food for thought in the article written by Bill Allan and published under the above title in this issue. There will be some who will disagree in some respects with the conclusions arrived at, but all products manufacturers know that the industry as a whole must give the subject of equipment costs per unit produced more serious attention.

Concrete Products Advertising Campaign Wins Support

Products Manufacturers Express Approval of Co-operative Advertising Campaign

THE co-operative national advertising campaign for concrete masonry that started early in June has evoked widespread support and approval by the concrete products industry. As described in the July issue of CONCRETE, it is planned to bring about an increase in market demand for concrete masonry by educating the building public to the merits and desirability of the product. National advertising has been chosen as the medium that will be most effective in accomplishing this education.

Campaign Purpose

The goal of the campaign is the development of an annual market for five hundred million units by 1933. The entire advertising program is being conducted as a special activity of the Concrete Products Association. Plans for the campaign explaining how the advertising is to be published and financed were mailed to all concrete masonry manufacturers with an invitation to participate actively in the movement.

Products Men Respond

This invitation has brought replies from products men in all parts of the country. Their letters indicate that the need for confidence-building publicity is recognized by all concrete masonry salesmen, and that the present campaign comes at an opportune time.

Some Comments

From Aberdeen, Washington, one of the points farthest west in the concrete masonry field, Earl Bracken of the Grays Harbor Cement Products Company writes to the Committee on National Advertising: "We are beginning to develop Supertile here in the timber country. It is a slow process and our production is small. However, we want to help and are enclosing our check for the fund for national advertising."

Meanwhile, from the other side of the continent, Stephen R. Brown, products manufacturer of Chatham, New Jersey, forwards his check without comment except, "Will send more next month," and Samuel D. Brown of the Pottstown Cement Block Company, Pottstown, Pennsylvania, writes: "Herewith our check for the fund for national advertising of concrete masonry."

Southern Interest

Down in Georgia, Stanley Elkan of the Elkan Stone-Tile Manufacturing Company, Macon, is another producer who forwards his check without comment. And from Dallas, Texas, Nolan Browne of the Penniman Gravel and Materials Company writes: "Here's my check. I have written to all members of the Texas Concrete Products Association about this movement. If I can be of further assistance, please advise me." Mr. Browne's letter had barely arrived before a check from the Turner Gravel Company, San Antonio, Texas, was received without comment from the writer.

J. H. Reeves of the Western Brick Company, Danville, Illinois, writes: "We are pleased to do our part to make the program a success and are enclosing check to help along this good work. We wish you every success and we hope that this program will lead to greater accomplishments." The Western Brick Company supplies haydite aggregate to products plants in the states of Illinois, Indiana, Michigan and Wisconsin. This firm also operates a large haydite concrete masonry plant in Danville.

A National Problem

These are a few of the many communications received from the men on the firing line, who are daily meeting with the sales resistance to concrete masonry that the national advertising campaign will help to overcome. The letters indicate that the industry's selling problem is truly national, even though the individual producers serve a purely local territory. Furthermore, the fact that support for the campaign is coming from producers of all types of units and materials demonstrates the progress that is being made toward unity in the concrete masonry industry.

Members of Committee

One of the important factors that is making for the success of the campaign is the personnel of the Committee on National Advertising, directly charged with responsibility for the advertising. The members are men of considerable experience in the concrete masonry field, who are engaged in lines representing the various interests in the industry.

D. R. Collins, chairman of the committee, has written many articles that have appeared in this magazine. He has just been appointed manager of the newly organized Milwaukee Co-operative Concrete Products Association, the sales organization of producers in that city. Mr. Collins will devote his entire efforts to marketing members' products.

H. E. Buchholz, secretary of the committee, is a partner in the Concrete Building Units Corporation, Oak Park, Illinois. His firm manufactures both sand and gravel and haydite units, with a production in 1928 of over one million block. Mr. Buchholz superintends sales and production activities at the plant.

W. R. Harris is sales and service engineer for the Cincrete Corporation of Milwaukee, one of the largest cinder block producing firms in the country. He is a past president of the Concrete Products Association. Austin Crabbs is manager of the Cement Products Company of Davenport, Iowa. He produces sand and gravel units in addition to a widely diversified line of concrete products of all types. A. G. Swanson, manager of the Omaha Concrete Stone Company, Omaha, Nebraska, has been a leader in the industry for a number of years. This year he is secretary of the Concrete Products Association. E. W. Dienhart, formerly manager of the Acme Concrete Tile Company of Cement City, Michigan, is now haydite sales and service engineer for the Hydraulic-Press Brick Company, Cleveland, Ohio.

"Tee Stone" Units Manufactured at Marlboro, N. Y., Plant

New York Products Plant Produces a Factory-Made Reinforced Concrete Unit Used for Walls and Floors—What the Unit Is and How It Is Manufactured

RECENTLY the Marlboro, N. Y., plant of the Terry & Tench Co. was enlarged for the third time to take care of the demand for the relatively new concrete product it is supplying to builders. The product manufactured, known as "Tee Stone," had been made at the job site in limited quantities for some time but, with improvements in the method of manufacture, it was found desirable to make the units at a central point and deliver them to the site. The Marlboro plant, which began operations last summer, is the first permanently located plant of this type.

What Tee Stone Is

Tee Stone is a method of building construction based on the use of a precast T-shaped unit made of reinforced concrete, as shown in Fig. 1.

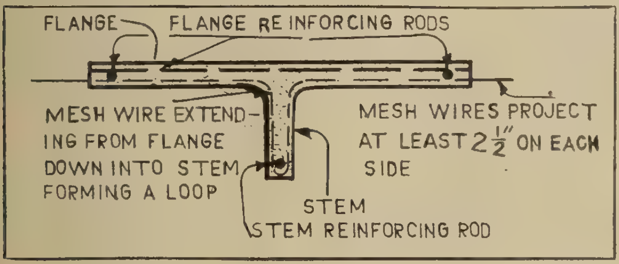

FLANGE
FLANGE REINFORCING RODS
MESH WIRE EXTENDING FROM FLANGE DOWN INTO STEM FORMING A LOOP
MESH WIRES PROJECT AT LEAST 2½" ON EACH SIDE
STEM
STEM REINFORCING ROD

Figure 1

The "T" consists of a flange and stem. The standard flange is 16 in. in width, but varies according to the requirements of the plans. The thickness is usually 1 in. The depth of the stem depends upon the thickness of the wall required or the depth of the floor beam. The thickness of the stem is usually 1 in. for wall slabs and 1¼ in. for floor beams, but may be easily increased, as required.

The reinforcement consists of mesh and rods. The mesh wires extend from the flange down into the stem, forming a loop as shown in Figure 1. They project at least 2½ in. on each side and overlap the extending wires of the adjacent units when placed in wall or floor formation. (See Figure 2.) This makes a continuous reinforcing, and, when the spaces between the units are pointed up with mortar, results in a monolithically reinforced concrete wall or floor slab. Shrinkage due to the setting of the concrete has already taken place in curing before the units are set in their final position. Consequently, the internal stresses which occur are, to a large extent, avoided. The only portion of the concrete that does produce strain during setting is that contained in the 1-in. space between the units,, which space is so heavily reinforced as to be amply capable of taking care of these forces. Particular attention was paid to this point because it has been so often raised.

Tee Stone reinforcing rods are located both in the flange and in the stem. These rods run both longitudinally and transversely in the flange and longitudinally in the stem. The flange rods are usually ¼-in. in diameter. Those in the stem vary from ¼-in. up depending upon the necessities of design. Tee Stone units may be designed by the ordinary formulas used in figuring reinforced concrete construction or by simple equations developed as the result of numerous tests and field applications. The mesh contained in the stem and flange extends from the ends as well as from the sides of the units and is used both for erection purposes and to unite the Tee Stone slabs into a monolithic structure.

Tests

Tests have shown that buildings erected of Tee Stone in this manner are homogeneous in construction and fully capable of taking care of foundation settlement without the development of faults or cracks. Figure 3 is a photograph of a test made on a Tee Stone unit at the Civil Engineering Testing Laboratories of Columbia University. It shows the marked deflection obtained. Failure occurred due to the stresses in the stem exceeding the elastic limit.

When the load was removed from the beam, it was found that the concrete in the compression flange was still intact. This is one of an extensive series of tests made under various conditions of span, loading, aggregates, reinforcement, and water-cement ratio on a large number of Tee Stone units.

A Tee Stone unit used in wall formation and corresponding to an 8-in. brick wall carried a test load of 90,300 lbs. for a 7-ft. height. It failed in compression-shear, which is an ideal form of compression failure. A Tee Stone unit 3½-in. deep overall and 7 ft. high carried a maximum load in compression of 63,000 lbs. and had a bending, long column failure. This is the type of failure to be expected where $1/r$ ratio is high. It is a slow, safe method of failure common in steel columns and shows the high safety factor of the unit.

Tee Stone beams have been designed and tested to carry

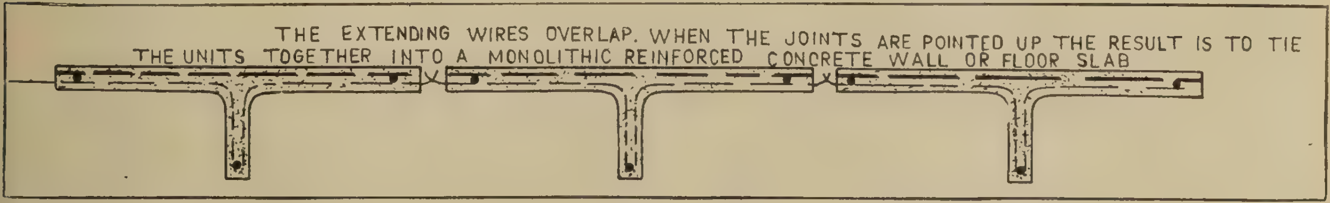

THE EXTENDING WIRES OVERLAP. WHEN THE JOINTS ARE POINTED UP THE RESULT IS TO TIE THE UNITS TOGETHER INTO A MONOLITHIC REINFORCED CONCRETE WALL OR FLOOR SLAB

Figure 2

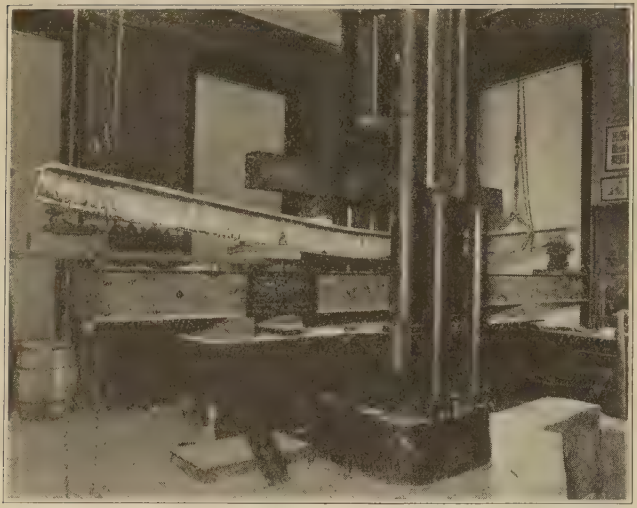


Figure 3

1150 lbs. per sq. ft. live-load over a 20-ft. span. These tests formed part of a complete series made on Tee Stone units in the Civil Engineering Testing Laboratories at Columbia University, the results of which were published in a volume issued by the university authorities.

Where the Units Are Used

Tee Stone units used in wall formation weigh from 12 to 17 lbs. per sq. ft. This compares to 80 lbs. per sq. ft. for an 8-in. brick wall. They may also be designed to carry any required horizontal as well as vertical pressure.

Tee Stone used in floor formation weighs 20 lbs. per sq. ft. This compares to from 45 lbs. to 100 lbs. per sq. ft. for concrete. The ordinary cinder concrete floor slab is limited to a span of about 6 to 8 ft. Floor units may be designed for any required load and span. The depth is determined by the deflection permitted and governed by the working stresses used in the steel and concrete.

They are adaptable to practically every type of construction. For example, they have been found suitable for bulkheading and a special system of design enables a

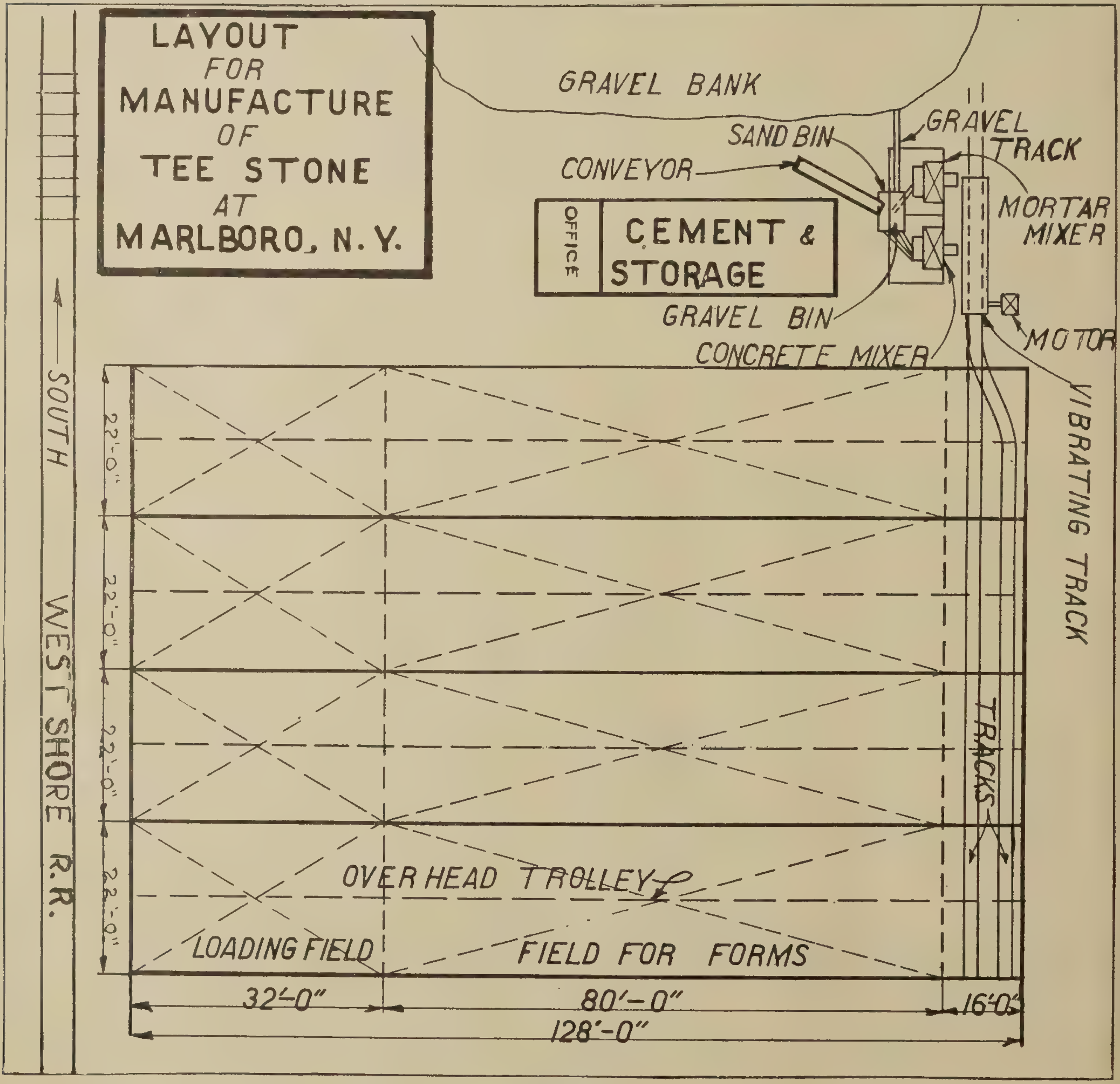


Figure 4

Tee Stone reinforced concrete bulkhead to be built at only a fraction of the cost of the standard type of reinforced concrete sea wall construction.

The Marlboro Plant

The first permanent Tee Stone plant was built by the Terry & Tench Company at Marlboro, New York. (See plan, Figure 4.) This location was chosen because it was adjacent to a mountain of 3/8-in. screened and washed gravel sufficient to make about 250,000,000 sq. ft. of Tee Stone. It is owned by the Rosoff Sand and Gravel Company who also agreed to furnish the required amount of screened, washed sand. The site has railroad as well as water facilities. However, strange as it may seem, it has been found most economical to ship the slabs as much as 65 miles from the plant to the job by means of trucks. This enabled daily deliveries and proved to cost less per square foot than any other method.

Essentially, the plant consists of two mixers; one used for making the mortar with which the lower portion of the stem is filled and the other mixer used for making the concrete with which the balance of the stem and flange are filled. Overhead bins supply sand and gravel in predetermined quantities for each batch. The gravel used is 3/8-in. gravel; that is, retained on a 1/4-in. sieve and passing through a 3/8-in. sieve. A 1:2:2 mix is used and 2 lbs. of calcium chloride are added per bag of cement.

The forms are delivered to the mixers by means of a truck traveling on a light track. About 24 ft. of this track directly in front of the mixers is free and rests upon a vibrating platform which is operated by means of a light motor rotating a shaft with two eccentric lugs or cams attached thereto. (See Figure 5.) The speed of the motor is reduced so that it rotates about 250 times per minute, producing a pulsating action both longitudinally and transversely. This action takes place while the concrete is being poured into the forms and results not only in thoroughly packing it around the reinforcing and into all the spaces intended for it, but it also releases the air bubbles which are driven to the surface and expelled. In addition, the surplus water is brought to the top where it is skimmed off, thus decreasing the water-cement ratio. A dense concrete of high strength is the result.

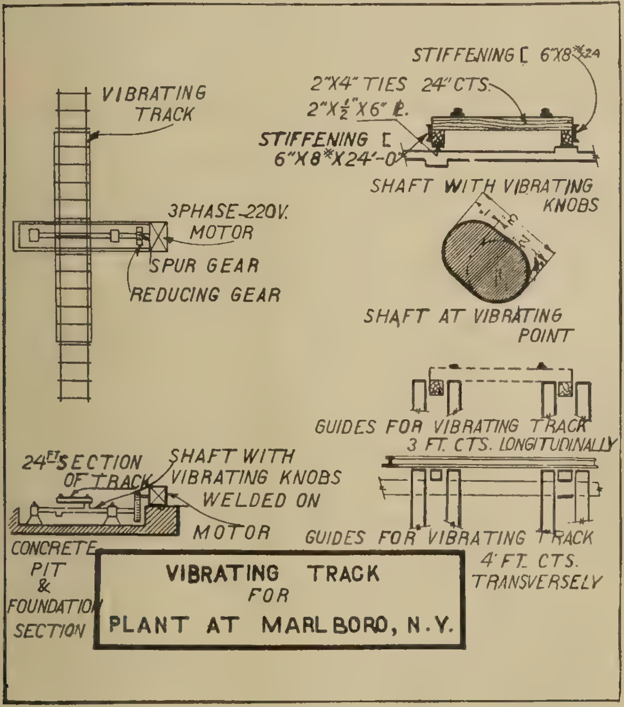
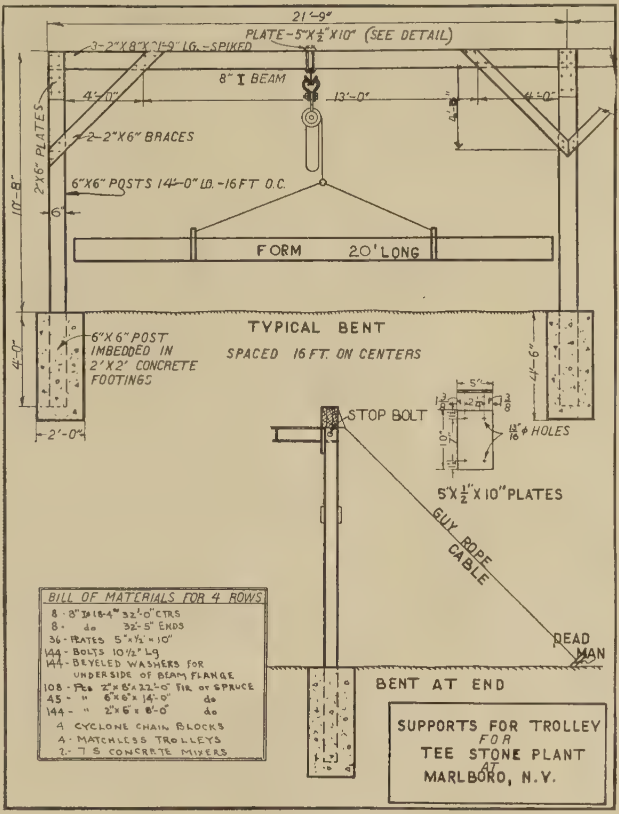

STIFFENING [6"X8"X24
2"X4" TIES 24" CTS.
2"X½"X6" ℓ.
VIBRATING TRACK
STIFFENING [6"X8"X24'-0"
SHAFT WITH VIBRATING KNOBS
3 PHASE-220V. MOTOR
SPUR GEAR
REDUCING GEAR
SHAFT AT VIBRATING POINT
GUIDES FOR VIBRATING TRACK 3 FT. CTS. LONGITUDINALLY
24 FT. SECTION OF TRACK
SHAFT WITH VIBRATING KNOBS WELDED ON
MOTOR
GUIDES FOR VIBRATING TRACK 4 FT. CTS. TRANSVERSELY
CONCRETE PIT & FOUNDATION SECTION
VIBRATING TRACK FOR PLANT AT MARLBORO, N.Y.

Figure 5

Forms

The rest of the plant consists of a large field covered with a shed. It is here that the empty forms are prepared for casting and the filled forms are delivered and stacked away for curing. The forms are brought to the track leading to the mixers by means of a chain pulley and overhead trolley system, and in the same manner are returned to the field. (See Figure 6.)



BILL OF MATERIALS FOR 4 ROWS
8 - 8" I @ 18.4# 32'-0" CTRS
8 - do 32'-5" ENDS
36 - PLATES 5"x½"x10"
144 - BOLTS 10½" Lg
144 - BEVELED WASHERS FOR UNDERSIDE OF BEAM FLANGE
108 - Pcs 2"x8"x22'-0" FIR or SPRUCE
45 - " 6"x6"x14'-0" do
144 - " 2"x6"x8'-0" do
4 CYCLONE CHAIN BLOCKS
4 - MATCHLESS TROLLEYS
2 - 7 S CONCRETE MIXERS

Figure 6

A form consists of two angular-shaped members each made up of a vertical and horizontal portion. (See Figure 7.) One-half of the form is attached to a framework. The other half is free so that it may be released for the removal of the Tee Stone units when they are sufficiently set. Longitudinal width gauge strips attached to the top of the forms determine the width and thickness of the flange. The longitudinal depth gauge strips attached to the vertical portions of the forms determine the thickness and depth of the stem. End pieces or bulkheads fix the length of the unit.

The units are usually permitted to remain in the forms about 48 hours although it has been found practical to remove them in 24 hours. They may be shipped within 4 days after casting and this is done quite frequently although better practice would suggest allowing them to be cured a longer period. The interior of the plant is usually kept at a temperature not below 65 deg. F. The units are wetted down at least twice a day and an effort is made to keep them in at least a damp condition until they are ready to be shipped.

Costs

By efficient management it has been found possible to produce these units, deliver, and erect them at a cost hardly exceeding that of wood construction for exterior

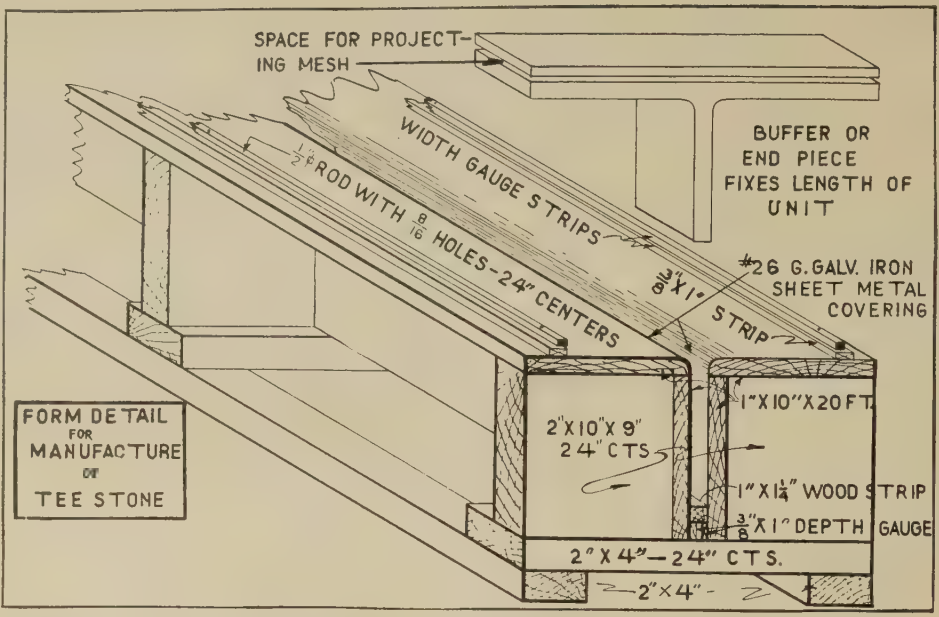

SPACE FOR PROJECTING MESH
BUFFER OR END PIECE FIXES LENGTH OF UNIT
WIDTH GAUGE STRIPS
1/2"ϕ ROD WITH 8/16 HOLES-24" CENTERS
#26 G. GALV. IRON SHEET METAL COVERING
3/8"X1" STRIP
2"X10"X 9" 24" CTS
1"X10"X20 FT.
1"X1¼" WOOD STRIP
3/8"X1" DEPTH GAUGE
2"X4"—24" CTS.
2"×4"
FORM DETAIL FOR MANUFACTURE OF TEE STONE

Figure 7

walls. When used for interior partitions, they cost about 10 cents per sq. ft. additional over wood partitions. When used in fireproof floor construction, the cost is somewhat higher than wood joists, but much less than ordinary fireproof floor construction. The result is that Tee Stone enables the erection of fireproof buildings at only a small fraction of the cost over that of the flammable type of wood construction.

The unit was developed and patented by Joseph Winston, vice-president of the Tee Stone Corporation, New York.

Damp Sand Job Curing Gives Erratic Results

By **HARLAN H. EDWARDS, C. E.**
Supervising Engineer, Scripps College, Claremont, California

Through tests conducted on a number of Southern California structures it has been conclusively demonstrated that for accurate work, quality cylinders should be cured under standard conditions in the laboratory, and that cylinders cured in damp sand on the job as required by A. S. T. M. specification C 31-21 often give low and erratic results. These tests were first made by the writer on structures at Pasadena, California, repeated and verified by Harvey Hincks, construction engineer on the Pasadena City Hall, and were later further verified personally on structures for Scripps College at Claremont, California.

On the work at Pasadena first mentioned, unaccountably low results were being reported by the laboratory on routine cylinders, so every possible source of trouble was checked without avail. Finally a set of cylinders were made, half of which were cured on the job in damp sand while the other half went to the laboratory and were cured approximately under standard conditions. The average daily temperature of the sand was taken and the results solved our problem. They were:

7 Days		28 Days	
Damp Sand 47 deg. F. Lbs./sq. in.	Laboratory 68 deg. F. Lbs./sq. in.	Damp Sand 47 deg. F. Lbs./sq. in.	Laboratory 68 deg. F. Lbs./sq. in.
905	1338	2100	2635
766	1064	1582	2138

Although days were warm, the damp sand retained the cold of the nights through evaporation of water during the day. This was not true in case of the structure. While rapid evaporation of water from the damp sand kept the day temperature of the sand from rising appreciably, the walls of the structure received heat from the warm air on all sides as well as from the heating effect of the sun—all of which far exceeded the slight cooling effect of evaporation on the mass of concrete.

It was plainly evident, therefore, that in places where day and night temperatures were not very much alike, large errors could creep into otherwise carefully controlled tests, giving final results which were misleading and incorrect.

New Books

Concrete Plain and Reinforced. By Taylor, Thompson and Smulski, Volume 2, (Fourth Edition). Published by John Wiley & Sons, Inc., New York.

This work has so long been recognized as standard that it is scarcely conceivable that there is anyone active in the field of concrete construction who is not more or less familiar with it in one of its earlier editions. The entire work is being at present revised and rewritten, the volume under consideration being the second in a contemplated series of four. This particular volume deals with the theory and design of continuous beams, frames, building frames, and arches. In other words, it is given over to the more complex forms of design with which the modern engineer finds it necessary to be familiar.

The material contained in this volume seems to have been brought carefully up-to-date, and there is little question but that the book will continue to maintain its recognized position in its new form.

COMING CONVENTIONS

American Road Builders Association — January 11th to 18th, 1930. 27th annual convention and road show, at Atlantic City, New Jersey.

Design of a Concrete Mixture

A Half-Calculation, Half-Trial Method for Designing Water-Cement Ratio Concrete Mixtures, Based on the Expanded Voids of the Aggregates

By R. P. V. MARQUARDSEN
Assistant Engineer, Chicago Terminal Improvement, Illinois Central Railroad Company

Part I

IN the third edition of "Design and Control of Concrete Mixtures," recently issued by the Portland Cement Association, the calculation method of designing concrete mixtures has been eliminated.

Inasmuch as the calculation method given in the previous editions was based on the "fineness modulus" analysis of the aggregates (which method is somewhat unreliable), the elimination of the calculation method probably is to be commended, but whether the straight-trial method outlined in the pamphlet can take the place entirely of all calculation methods remains to be seen.

Most engineers, I am afraid, will consider it inadvisable to leave the design of concrete mixtures entirely to the judgment of the individual inspector without providing some means for his guidance.

It is contended by those favoring the calculation method that, inasmuch as the sieve analysis should not be omitted even if the straight-trial method is used (because it teaches the inspector to know suitable aggregates) and inasmuch as the sieve analysis is the portion of the calculation method that requires the most work, some sort of calculation method based on the sieve analysis of the aggregates might just as well be employed in determining the proper mix, instead of trusting entirely to the judgment of the individual.

I agree fully with the view that the sieve analysis tends to educate the inspector in the matter of suitable aggregates, but the sieve analysis used in calculating the fineness modulus of an aggregate, viz., expressing the per cent of aggregate retained on the several sieves when the total aggregate of the sample is passed over each sieve, does not convey adequately to the mind the grading of the aggregate. It seems to me that a better way to express the grading of an aggregate would be to establish the per cent of each portion having grains of the same average size; i. e., the per cent of aggregate retained on the several sieves when the total aggregate of the sample is first passed over the largest sieve, then the rest of the aggregate over the next largest sieve, then the remainder over the third largest, etc. This method, which, of course, is not new, is indicated in the following scheme:

Typical Sieve Analysis of Fine Aggregate

Sieve No.	Per Cent of Aggregate	Average Size of Particles, In.
Passing No. 100	2	0.0044
No. 100-No. 50	10	0.0088
No. 50-No. 30	20	0.0176
No. 30-No. 16	25	0.0351
No. 16-No. 8	30	0.0702
No. 8-No. 4	10	0.1404
No. 4-⅜-in.	3	0.2810
Total	100	

Typical Sieve Analysis of Coarse Aggregate

Sieve Size	Per Cent of Aggregate	Average Size of Particles, In.
Passing No. 4	2	0.1404
No. 4-⅜-in.	10	0.2810
⅜-in.-¾-in.	20	9/16
¾-in.-1-in.	20	⅞
1-in.-1½-in.	20	1¼
1½-in.-2-in.	15	1¾
2-in.-3-in.	13	2½
Total	100	

The sieves shown in the scheme are those required for the "Standard Method of Test for Sieve Analysis of Aggregates for Concrete" adopted by the American Society for Testing Materials. The "average size of particles" indicated is the sum of the opening size of the two sieves designating a group, divided by 2.

I doubt very much if it is possible to devise a straight calculation method that will give accurately the most economic mix, the desired workability, the required strength, etc. At any rate, if it should be possible to devise such a method it probably would be too cumbersome to be of any practical use.

It should be entirely feasible, however, to develop a logical half-calculation, half-trial method that would not be too complicated for practical use, and in what follows I shall outline a method of this nature.

Basic Facts to Be Remembered

In order that the reader may understand the method more readily, the following facts relating to the water-cement ratio theory should be borne in mind:

(a) Other conditions being equal (such as time of mixing, manner of curing, etc.) the strength of concrete depends solely upon the ratio of water to cement, provided the mixture is workable and the aggregates are structurally sound.

(b) The grading of the aggregates and the ratio of coarse to fine aggregates is unimportant (as far as strength is concerned), provided the resulting mixture is not harsh and does not produce honeycombed concrete.

It would be still better if the reader would take the time to read F. R. McMillan's paper entitled, "Concrete Primer," which was presented at the 24th annual convention of the American Concrete Institute, held at Philadelphia, on February 28th and 29th and March 1, 1928. This paper presents, in a sensible manner and in understandable English, all that any engineer needs to study in order to obtain an up-to-date knowledge of the fundamental principles governing concrete mixtures.

Water-Cement Ratio

The water-cement ratio to be used for a required strength, or a given class, of concrete will be stated in the specifications governing the work at hand and need not be considered in detail. Figure 1 shows graphically the ratios adopted by the American Railway Engineering Association in March, 1927. Similar curves might be prepared from the ratios adopted by other organizations.

Grading of Aggregates

Although, as stated under (b), the grading of the aggregates is unimportant as far as strength is concerned, it should not be forgotten that the grading does influence the cost of the resulting concrete considerably. Favorably graded aggregates will require less paste (cement and water in the proper ratio) to produce a concrete of given consistency than will aggregates of uniform-size particles,

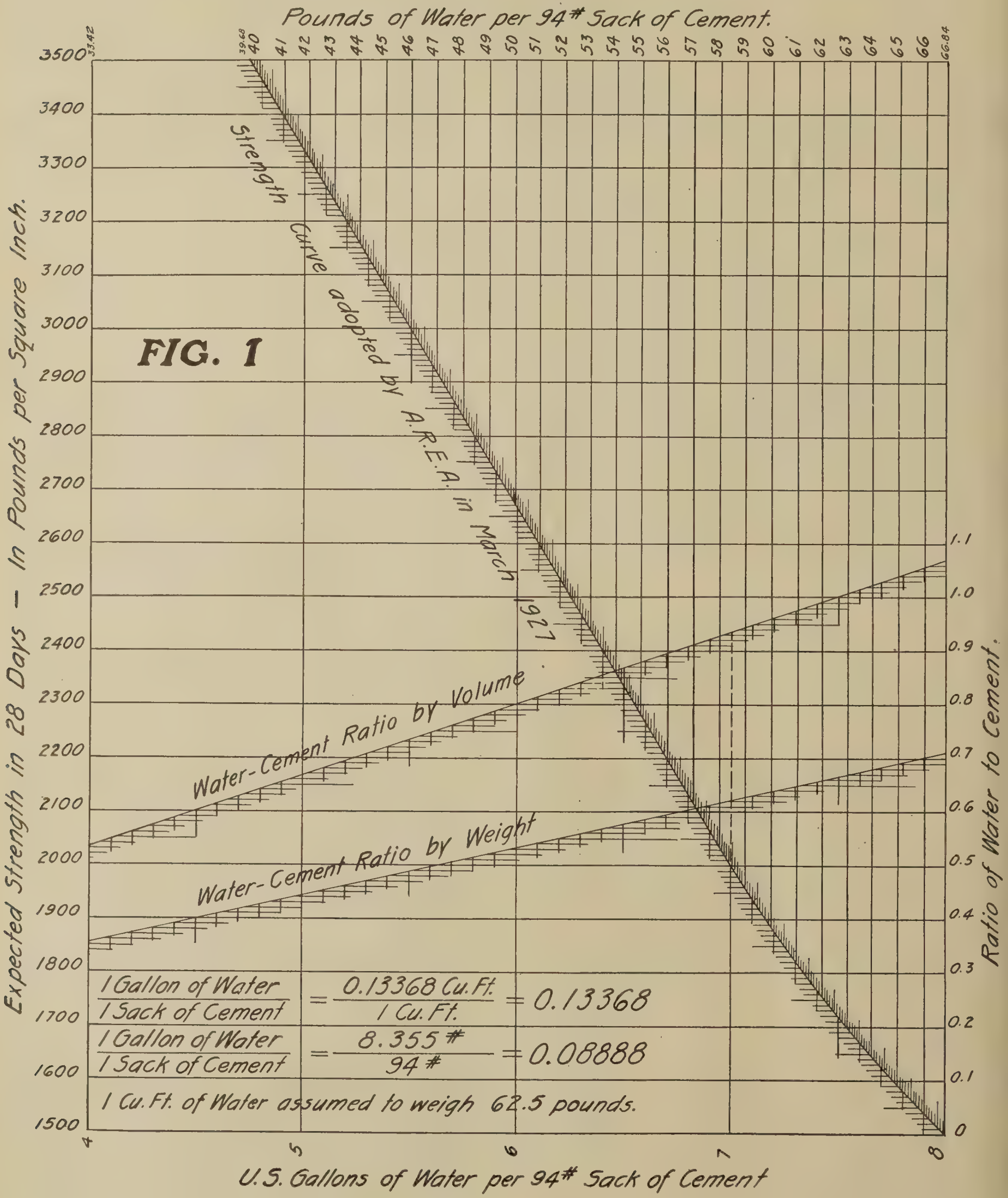


FIG. 1

so that, at times, it might be found economical to screen the aggregates into groups of uniform-size particles and recombine the several groups in such proportions as will give the most favorable grading.

For the purpose of outlining a procedure to be followed in designing a concrete mixture when certain coarse and fine aggregates are to be used regardless of their grading, the matter of economical grading will, however, not need attention.

Problem at Hand

If, then (at the present time), we are not interested in knowing what grading of aggregates will be the most economical, but are interested only in obtaining a concrete of a given water-cement ratio and consistency by using the available materials as they are, we may state the problem before us as follows:

Given: Certain aggregates (coarse and fine) structurally sound, but not graded in any particular manner.

To find: The most economical mix (using the aggregates as they are) that will produce a non-honeycombed concrete of a given water-cement ratio and of fairly easy placing capacity or workability.

Although the slump test is not an entirely satisfactory measure of workability, specifications generally give certain slump limits that must be maintained for the several classes of concrete required. The slump therefore must be considered in connection with the design of a concrete mixture.

Proportioning for Economy

The most economical concrete (as far as the cost of materials required is concerned, if the difference between the price of coarse aggregate and the price of fine aggregate is not too great) is one in which the expanded voids of the coarse aggregate are just filled by the mortar (sand, cement, and water mixed in the proper ratios), as this is the least quantity of mortar (and consequently the least quantity of cement) that can be used without producing honeycombed concrete.

Similarly, it may be reasoned that the least quantity of paste (cement and water mixed in the proper ratio) required to prevent voids in the mortar is the quantity that will just fill the expanded voids of the fine aggregate. For workability reasons, however, a slightly greater amount of paste may be required.

The expanded voids of the coarse aggregate may be considered to be the natural voids of the loose coarse aggregate, as increased by the "weighted" size of the fine aggregate plus the "weighted" size of the cement. The term "weighted" will be explained later.

Similarly, the expanded voids of the fine aggregate may be considered to be the natural voids of the loose fine aggregate, as increased by the "weighted" size of the cement used. A given quantity of fine aggregate (whether dry, damp, or wet) will occupy the same space when poured into water, provided it is entirely submerged. The volume of fine aggregate when so measured, therefore, may be taken as the standard volume of loose fine aggregate, and the voids in the standard volume of loose fine aggregate as the natural voids of the loose fine aggregate.

The Basic Theory

The theory underlying the method of designing water-cement ratio concrete mixtures therefore may be summed up as follows:

1. The ratio of fine aggregate to coarse aggregate should be determined by ascertaining the quantity of fine aggregate contained in the least quantity of mortar required to fill the expanded voids of a given volume of loose coarse aggregate.

2. The minimum ratio of cement to fine aggregate should be determined by ascertaining the quantity of cement contained in the least quantity of paste required to fill the expanded voids of a given standard volume of loose fine aggregate. This minimum ratio of cement to fine aggregate should be used in making a trial batch of concrete, and the final ratio of cement to fine aggregate should be found by trial, by adding small quantities of paste (cement and water in the proper ratio) to the trial batch until the desired workability is obtained.

3. The ratio of water to cement, given by the specifications, should, of course, be governed by the strength of concrete required.

Mortar Required and Ratio of Coarse to Fine Aggregate

To establish a method for determining the quantity of mortar required to fill the expanded voids of a given volume of loose coarse aggregate, assume for the time being that all particles of the coarse aggregate are perfect cubes of the same size, r'', and so arranged as to leave no voids. A cross-section of the particles so arranged is indicated in Figure 2, at (a).

Assume also that all particles of the fine aggregate are of the same size, s'', and that the cubes of the coarse aggregate are forced apart by the fine-aggregate particles as indicated at (b).

Neglecting for the present the "weighted" size of the cement, the space between the coarse-aggregate particles then represents the least quantity of mortar that would be required to fill the expanded voids of the coarse aggregate, and the total volume represents the quantity of concrete produced by the mortar and the coarse aggregate.

The cross-section of a single particle of the coarse aggregate with its expanded voids is indicated at (c). From a study of this enlarged view it is evident that the concrete produced by a single particle (and its corresponding mortar) is equal to $(r'' + s'')^3$. The "loose" volume of the particle (in this case equal to its absolute volume) is equal to r''^3 and the volume of the mortar is equal to $(r'' + s'')^3 - r''^3$.

Particles Irregular in Shape

If the particle of coarse aggregate is irregular in shape, as indicated at (d), but such as to be contained in a cube with sides equal to r'', the volume of the concrete produced would still be equal to $(r'' + s'')^3$ and the "loose" volume of the particle still equal to r''^3. The volume of the mortar, however, would be increased by the natural voids of the particle and thus become equal to $(r'' + s'')^3 - r''^3 + vr''^3$, v being the unit natural-voids factor of the particle.

The volume ratio of concrete produced to loose coarse aggregate (neglecting the "weighted" size of the cement) is therefore equal to $(1 + s''/r'')^3$ for a coarse aggregate of uniform-size particles if the fine aggregate in the mortar also consists of uniform-size particles.

If the fine aggregate in the mortar, however, consists of different-size particles, the volume ratio of concrete produced to loose coarse aggregate is equal to $\Sigma(p \div 100)(1 + s''/r'')^3$, p being the per cent of each group of fine-aggregate particles of size, s''. This is illustrated in the following scheme where a value of 0.75 in. has been used for r'':

Typical Method for Determining the Volume Ratio of Concrete Produced to Loose Coarse Aggregate Consisting of Uniform Size Particles. (Weighted size of cement not considered)

$r'' = 0.75$ in.

Sieve No.	Per Cent of Fine Aggregate $= p$	Average Size of Particles, In. $= s''$	$(p \div 100)$ $(1 + s''/r'')^3$
Passing No. 100	2	0.0044	0.020
No. 100-No. 50	10	0.0088	0.104
No. 50-No. 30	20	0.0176	0.214
No. 30-No. 16	25	0.0351	0.288
No. 16-No. 8	30	0.0702	0.392
No. 8-No. 4	10	0.1404	0.167
No. 4-⅜-in.	3	0.2810	0.078
Total $= \Sigma(p \div 100)(1 + s''/r'')^3 =$			1.263

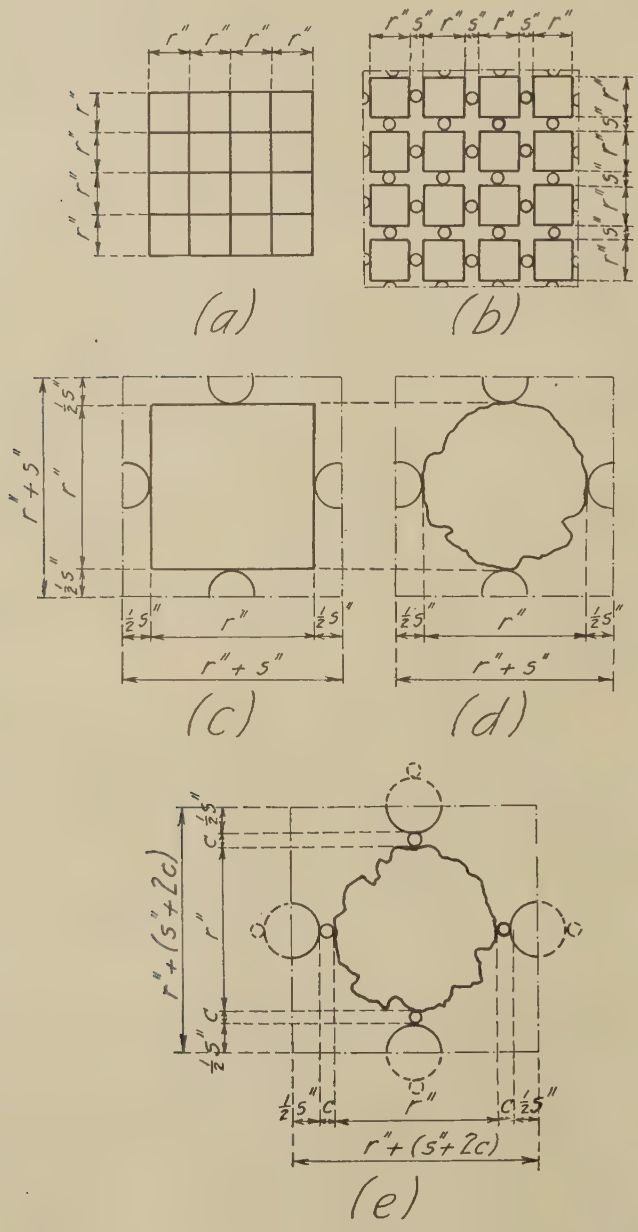


FIG. 2

Instead of calculating the volume ratio of concrete produced to loose coarse aggregate by this method, a "weighted" value of the sizes of fine aggregate particles can be established such that $\Sigma(p \div 100)(1 + s''/r'')^3$ may be expressed by $(1 + s/r'')^3$ in which s is the "weighted" size of the fine aggregate. An approximate method, good enough for all practical purposes, for establishing the "weighted" size of the fine aggregate is indicated in the following scheme:

Typical Method for Establishing the Weighted Size of Fine Aggregate

Sieve No.	Per Cent of Fine Aggregate $= p$	Average Size of Particles, In. $= s''$	$(p \div 100) s''$
Passing No. 100	2	0.0044	0.0000
No. 100-No. 50	10	0.0088	0.0009
No. 50-No. 30	20	0.0176	0.0035
No. 30-No. 16	25	0.0351	0.0088
No. 16-No. 8	30	0.0702	0.0211
No. 8-No. 4	10	0.1404	0.0140
No. 4-⅜-in.	3	0.2810	0.0084
Total = Weighted size of aggregate =			0.0567 =

The volume ratio of concrete produced to loose coarse aggregate being equal to $(1 + s/r'')^3$ *for* a coarse aggregate consisting of uniform-size particles (regardless o what the grading of the fine aggregate is), the volum ratio of concrete produced to loose coarse aggregate fo a coarse aggregate consisting of different-size particles i equal to $\Sigma(p \div 100)(1 + s/r'')^3$, p in this case being th per cent of each group of coarse aggregate particles o size r''. This is illustrated in the following scheme wher a value of 0.053 in. has been used for s:

Typical Method for Establishing the Volume Ratio of Concrete Produced to Loose Coarse Aggregate Consisting of Different-Size Particles. (Weighted size of cement not considered)

$s = 0.053$ in.

Sieve Size	Per Cent of Coarse Aggregate $= p$	Average Size of Particles, In. $= r''$	$(p \div 100)$ $(1 + s/r'')$
Passing No. 4	2	0.1404	0.052
No. 4-⅜-in.	10	0.2810	0.169
⅜-in.-¾-in.	20	9/16	0.262
¾-in.-1-in.	20	⅞	0.240
1-in.-1½-in.	20	1¼	0.227
1½-in.-2-in.	15	1¾	0.167
2-in.-3-in.	13	2½	0.139
Total $= \Sigma(p \div 100)(1 + s/r'')^3 =$			1.256

Instead of calculating the volume ratio of concrete pr duced to loose coarse aggregate by this method, "weighted" value of the reciprocal of the several sizes c the coarse-aggregate particles can be established such tha $\Sigma(p \div 100)(1 + s/r'')^3$ may be expressed by $(1 + sr')$ in which r' is the "weighted" size reciprocal of the coars aggregate. An approximate method, good enough for a practical purposes, for establishing the "weighted" siz reciprocal of the coarse aggregate is indicated in th

(Continued on Page 56)

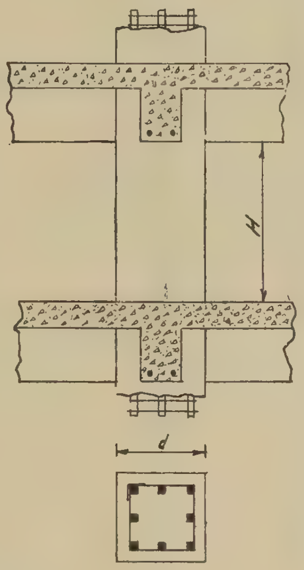
Reinforced Concrete Design Simplified

Chart O—Tied Columns

By PROF. JAMES R. GRIFFITH
Professor of Structural Engineering, Oregon State Agricultural College, Corvallis, Ore.

Joint Committee Specifications

$f_s = 18{,}000$ lbs. per sq. in.
$f'_c = 2{,}000$ lbs. per sq. in.
$f_c = 400$ lbs. per sq. in.
$P = (A'_c + A_s n)\, f_c$
H/R less than 40



TIED columns are uneconomical as compared to spiral reinforced columns. There are, however, many conditions requiring tied columns due to the limited sizes of commercial spirals.

Application of Chart O

Under Chart M a spiral reinforced column was designed for the conditions:

Total column load = 400,000
Column dimensions:
24 x 24 in. overall
Height, floor to beam bottom = 12 ft.

Chart M gave a value for longitudinal steel of

$$A_s = 12.2 \text{ sq. in.}$$

In order to make possible a comparison between spiral reinforced and tied columns, I will take this same column load. Chart O is solved by one isopleth. If the same size, 24 by 24, is tried, a straight line from a 24-in. column through the 400,000-lb. load gives a value of

$$A_s = 30 \text{ sq. in.}$$

However, the Joint Committee Specifications limit the maximum amount of longitudinal steel to two per cent of the total column area. Thus the maximum longitudinal steel would be

$$\text{Maximum, } A_s = 24 \times 24 \times 0.02 = 11.5 \text{ sq. in.}$$

Using a 24- by 24-in. column with this maximum amount of steel, Chart O indicates a maximum column load of slightly less than 300,000 lbs. So a 24-in. square column is not large enough for the given load. As indicated, a horizontal isopleth on Chart O gives the maximum amount of longitudinal steel as permitted by the specifications. A horizontal isopleth through the 400,000-lb. load indicates that the minimum column size is slightly under 28 by 28 in. Using a 28-in. square column, isopleth (1) on Chart O gives a value of

$$A_s = 15.2 \text{ sq. in.}$$

From Chart C using twelve 1⅛-in. square bars we find

$$A_s = 15.2 \text{ sq. in.}$$

Comparing these results for a tied column to those required for a spiral reinforced column, the following additional material is shown to be necessary:

Concrete = 36.6 per cent additional
Longitudinal steel = 24.6 per cent additional

When the ratio of H/R becomes greater than 40 the Joint Committee specifies that the permissible working load on the column shall be figured by the formula

$$P'/P = 1.33 - H/120\,R \qquad \text{Eq. 1-N}$$

P' = Total safe axial load on long column.
P = Total safe load on column of same section when H/R is less than 40.
R = Least radius of gyration of column.

When figuring R for spiral reinforced columns the core only is used.

$$R = d/4 = 0.25\,d$$

d = Diameter of column core.

Chart N was designed to solve Eq. 1-N for circular cores.

As discussed under Chart N, when tied rectangular columns are used the least radius of gyration is figured by

$$R = 0.288675\,d$$

d = Least column dimension.

As previously stated this is so nearly the equivalent to that of circular cores that for all practical purposes Chart N

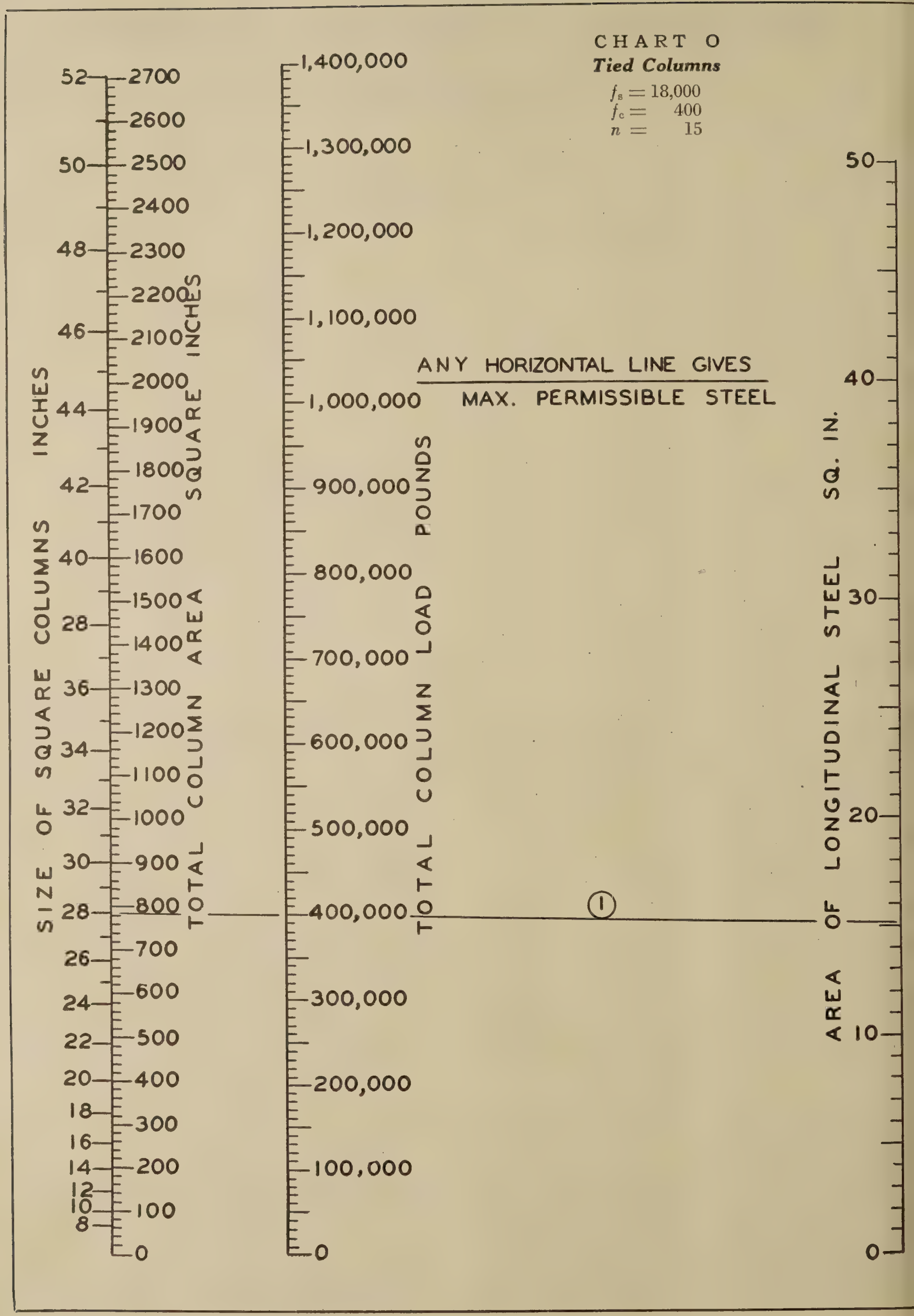


CHART O

Tied Columns

$f_s = 18{,}000$
$f_c = 400$
$n = 15$

may be used for determining the safe load on long rectangular tied columns.

Joint Committee Specifications

The Joint Committee Specifications state "The safe axial load on columns reinforced with longitudinal bars and separate lateral ties shall be not greater than that determined by the formula

$$P = (A'_c + A_s n)\, f_c \qquad \text{Eq. 1-O}$$

A'_c = Net area of concrete in the column, total column area minus area of reinforcement;

A_s = Effective cross-sectional area of longitudinal reinforcement;

f_c = Permissible compressive stress in concrete and shall not exceed $0.20\, f'_c$.

The amount of longitudinal reinforcement considered in the calculations shall be not more than 2 per cent nor less than 0.5 per cent of the total area of the column. The longitudinal reinforcement shall consist of not less than four bars of minimum diameter of ½ in., placed with clear distance from the face of the column not less than 2 in.

"Lateral ties shall be not less than ¼ in. in diameter, spaced not more than 8 in. apart."

Construction of Chart O

Using concrete with an ultimate strength of $f'_c = 2{,}000$ lbs. per sq. in., the working stress in the concrete becomes

$$f_c = 0.2 \times 2000 = 400 \text{ lbs. per sq. in.}$$

Equation 1-O, with a value of $n = 15$, then reduces to

$$P = (A'_c + 15\, A_s)\, 400$$

But $A'_c = A_c - A_s$, where A_c is the total column area. Then

$$P = (A_c - A_s + 15\, A_s)\, 400$$
$$P = (A_c + 14\, A_s)\, 400$$
$$P = 400\, A_c + 5600\, A_s \qquad \text{Eq. 2-O}$$

The plus (+) sign in Eq. 2-O makes it resemble the general expression

$$C = \frac{mn}{r} L + m(1 - n)\, R \qquad \text{Eq. 6}$$

requiring rectangular co-ordinates for nomographic construction.

In the introduction to this series and the derivation of the general equations for nomographic construction, I defined the ratios

$$r = \frac{\text{size of } R \text{ co-ordinates}}{\text{size of } L \text{ co-ordinates}}$$

$$m = \frac{\text{size of } R \text{ co-ordinates}}{\text{size of } C \text{ co-ordinates}}$$

When using rectangular co-ordinates I find these ratios easier to express in terms of the number of graduations per inch. The ratios then become

$$1/r = \frac{\text{Number of } R \text{ graduations per inch}}{\text{Number of } L \text{ graduations per inch}}$$

$$1/m = \frac{\text{Number of } R \text{ graduations per inch}}{\text{Number of } C \text{ graduations per inch}}$$

The left (L) scale will contain values of (A_c), the right (R) scale values of (A_s), and the central (C) scale values of the total column load (P). In order to get the necessary limits in the space permitted I have assumed the scales

$$A_c,\ 1'' = 300 \text{ sq. in.}$$
$$A_s,\ 1'' = 6 \text{ sq. in.}$$

I will then have a ratio

$$1/r = 6/300 = 1/50$$

or

$$r = 50$$

Equating the general co-efficients of the variables of Eq. 6 to the specific ones of Eq. 2-O and substituting the value of ($r = 50$), I have

$$\left.\begin{aligned} mn/r = mn/50 &= 400 \\ m(1 - n) &= 5600 \end{aligned}\right\}$$

Solving these two expressions simultaneously for values of (n) and (m) I get

$$\left.\begin{aligned} n &= 0.782 \\ m &= 25{,}600 \end{aligned}\right\}$$

Thus the central (C) scale must be located 0.782 the total distance between outside scales from the right (R) scale. Also

$$1/m = \frac{\text{Number of } R \text{ graduations per inch}}{\text{Number of } C \text{ graduations per inch}}$$

$$1/25{,}600 = 6/\text{Number of } C \text{ graduations per inch.}$$

The central (C) scale will then be

$$P,\ 1'' = 6 \times 25{,}600 = 153{,}500 \text{ lbs. per in.}$$

Since this is an odd size not available directly as a scale the (C) scale was divided geometrically.

I started all scales with their origins at the construction isopleth. The point on the central (C) scale having a value of ($P = 1{,}000{,}000$ lbs.) will then be located

$$\frac{1{,}000{,}000}{153{,}500} = 6.52 \text{ in.}$$

up from the origin of that scale. With this point and the origin known the remaining graduations may be quickly obtained by geometric interpolation.

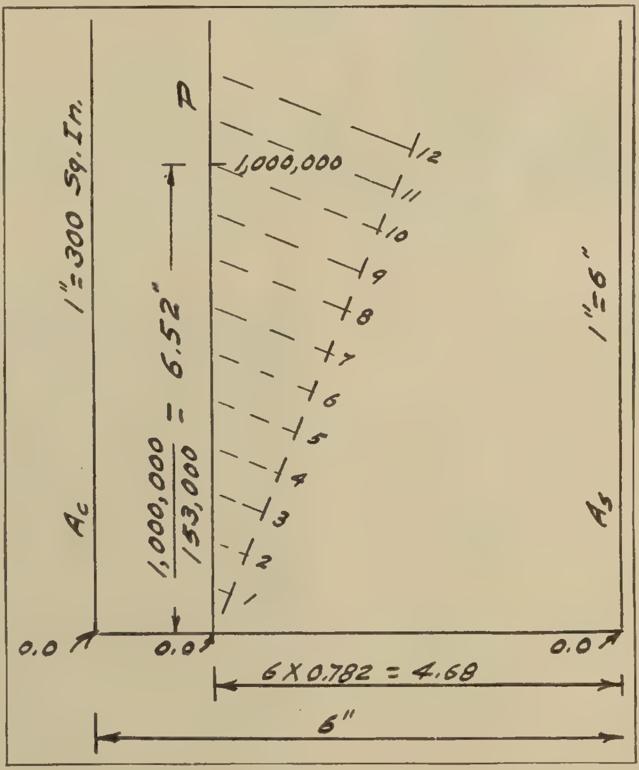


Figure 1-O

Figure 1-O gives the complete information by which the original of Chart O was constructed and also shows the method of graduating the central scale.

In making a choice of scale for (L) and (R), consideration was given to the maximum amount of longitudinal steel permitted by the specifications:

$$\text{Maximum, } A_s = 0.02\, A_c$$

So scales were chosen such that the number of graduations per inch on the (*R*) scale was 2 per cent of those on the (*L*) scale. Thus a horizontal line, parallel to the construction isopleth, would give at any place

$$A_s = 0.02\,A_c$$

So in order to keep under the maximum requirements of the specifications any solution isopleth must be horizontal or slope down to the right.

The left (*L*) scale is calibrated to give the column area and must be so used for rectangular columns. I have, however, shown the dimensions of square columns at their proper locations.

Several readers have protested about my original but unconventional method of solving for the relative size and spacing of scales. So perhaps it will be well to mention the conventional method of determining the nomographic characteristics. An optional method is always advantageous and I sometimes resort to it to find some mistake that I cannot find otherwise. It at least avoids simultaneous equations which some will claim is an advantage in itself.

The two outside scales are located and calibrated. Some value on the (*C*) scale is then assumed and two isopleths figured so as to intersect at this point. Assuming a value of ($P = 1{,}000{,}000$) for the intersection of the two isopleths I would have

$$P = 400\,A_c + 5600\,A_s \qquad \text{Eq. 2-O}$$

$$A_c = \frac{1{,}000{,}000 - 5600\,A_s}{400}$$

Substituting two optional values of (A_s) I get

$A_s = 50$
$A_c = 1800$
$A_s = 21.4$
$A_c = 2200$

These two isopleths are carefully drawn in. Through the intersection of the two isopleths the (*C*) scale is drawn parallel to the other scales. If the same scales and spacing for (*L*) and (*R*) as for Chart O are used the (*C*) scale will be found at the same location as placed before. The intersection of the two isopleths gives the location of one point on the (*C*) scale and the remainder can be calibrated as I did for Chart O. Care must be taken to choose isopleths that will not intersect at too flat an angle. As a whole I have not obtained results by this method with an accuracy comparable to the other method.

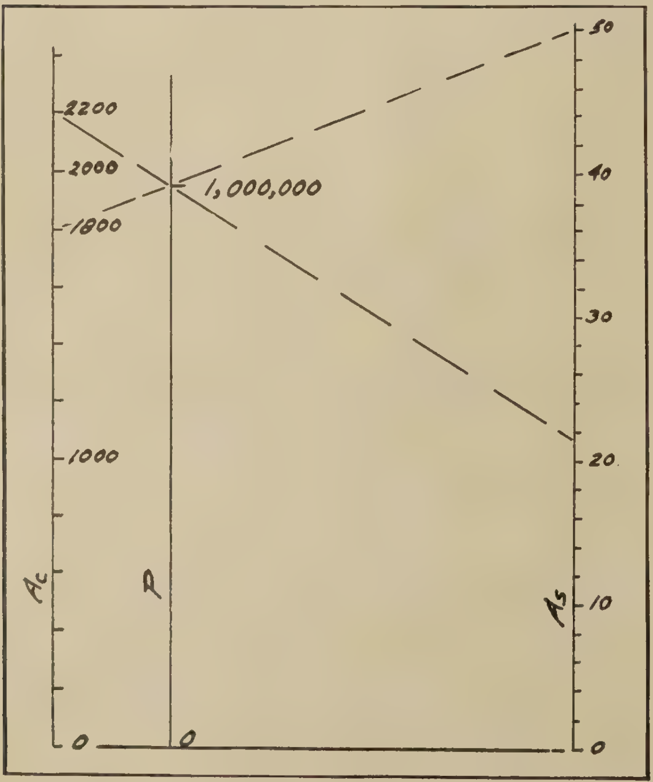


Figure 2-O

H. M. Hadley Receives New Coast Appointment

As the first step in an enlarged structural program, the Portland Cement Association has announced the appointment of Homer M. Hadley as regional structural engineer for the Pacific Coast. Mr. Hadley is to act in an advisory capacity to architects and engineers for the territory of California, Nevada, Arizona, Oregon, Washington and British Columbia.

Frank J. Barrett, former office manager and field engineer of the association's Seattle office, succeeds Mr. Hadley as district manager of the Pacific Northwest.

Mr. Hadley will maintain offices in Seattle. He will endeavor to correlate the structural activities of the Coast offices of the association, not only in the presentation of the merits and advantages of concrete as a structural material but also in the effort to assist users in obtaining concrete of the most satisfactory quality.

For the last seven years Mr. Hadley has been in the employ of the Association as field engineer and then as district engineer with offices in Seattle. He brings to his new post a structural experience both wide and varied.

Following the Tokyo and Santa Barbara earthquake disasters, Mr. Hadley served as investigating engineer for the Association. In both instances he rendered valuable assistance to structural engineering through his detailed surveys and reports of the effect of earthquakes on all types of construction.

Frank J. Barrett who steps into Mr. Hadley's former position as district manager of the Pacific Northwest, has been for the last nine years office manager and field engineer for the association's Seattle office.

Upon graduation, he spent a number of years engaged in surveying work for private engineering firms in and around Seattle. He has also held various positions in the engineering department of the Great Northern Railway.

In 1916 he entered the employment of the Washington Portland Cement Company. Two years later he entered the services of the Portland Cement Association as office manager of the Seattle office. He served in this capacity until 1927 when he was made field engineer.

New Building Code Committee Chairman

Dr. William K. Hatt, professor of civil engineering and director of the laboratory for testing materials, Purdue University, has been appointed by the Secretary of Commerce as chairman of the department of commerce building code committee.

Dr. Hatt has a long and distinguished record as an educator and engineer. His public service includes such positions as state engineer, Indiana State Conservation Department; director of the advisory board of highway research, National Research Council; and chief engineer, Indiana Flood Commission. He is past president and Turner medallist of the American Concrete Institute and holds the Fuertes metal from Cornell University. Dr. Hatt has served as a member of the Department of Commerce Building Code Committee for the past eight years.

The Navy Looks at Concrete

Wide Variety of Concrete Structures Built for Navy Use—Some Examples—Investigations Made to Determine Best Methods and Materials

By G. K. SPENCER

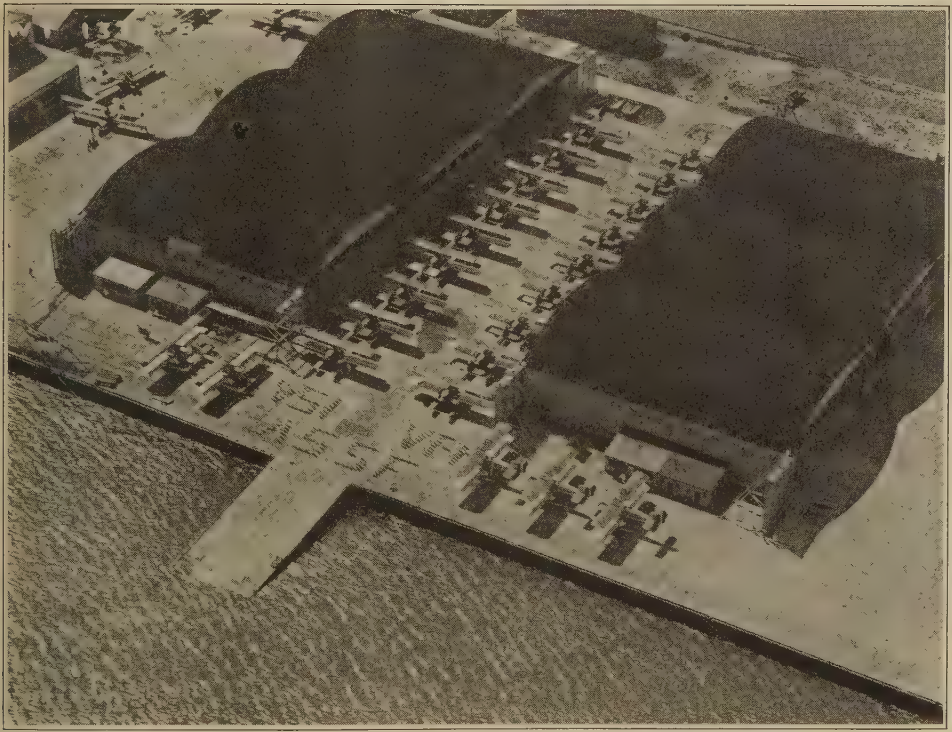
WITH a building schedule in excess of $13,000,000 in hand, for shore buildings in all its domains around the world, the navy of the United States is one of the foremost elements in the province of concrete during the present fiscal year, for approximately two-thirds of the entire program must, by Congressional requirement, be finished in the fiscal year of 1928-1929, and extensive researches by naval technicians have finally developed the superiority of concrete construction for waterfront works.

The navy's concrete tonnage will be radically enlarged following the more recent developments in research, and especially subaqueous construction in both tropical and temperate climates. Part of the program is already under way; it is the gigantic Naval pier at San Diego, all concrete, and 1,000 ft. long and 165 ft. wide. It will serve such vessels as the aircraft carriers "Saratoga" and "Lexington," which cannot come alongside ordinary piers. Naturally depths must be rather capacious for these ships, which is necessitating a great expense of concrete piling of the greatest lengths ever yet placed below a pier.

Naval aviation concrete piers at San Diego

In the more vital naval shore commands around the world, all timber is being removed and concrete construction placed in its stead. The work of constructing a reinforced concrete magazine wharf to replace the present timber wharf and that of partial reconstruction in reinforced concrete of the fuel-oil wharf at Guantanamo Bay is now in progress and is practically completed. At Cavite and at Honolulu extensive works in concrete have been inaugurated, and a sea wall at Key West, Florida, is also being built of concrete.

The project at Pearl Harbor possesses a special interest, for the extension of the First Street Pier at the naval operating base will be approximately 80 ft. wide and 248



The concrete docks, runways and hangars at Hampton Roads, Va.

ft. long and will consist of a reinforced concrete deck, beams, girders and floor slab supported and braced by composite piles of wood and precast concrete.

A Floating Dry-Dock

At the same time, the completion of the great naval dry-dock at Olongapo, China, of the floating type, represented another victory for tropical concrete construction. This dock will be towed in sections from Olongapo across the China Sea to Cavite in the near future. The size of the undertaking may be seen in the fact that the cost of merely towing this dock from Olongapo to Cavite will be $600,000. And even at that, a saving will be realized through handling the construction at Olongapo.

Showing the type of new naval piers and shipping centers being erected at important naval bases around the world

Concrete roads are now accepted as the naval standard and the laying of exclusively concrete roads at the San Diego destroyer base, marked the definite turning point in navy roadmaking in naval commands ashore. Henceforth roads in all climates, when laid for naval purposes, will be of concrete. It has been found by actual experience that the concrete road is more economical, and inasmuch as the Congressional policy for the navy is one of economy, there is great significance in the fact that a definite policy of economy on the part of a great government activity will lead to concrete construction. The navy experimented with many other forms of construction and its findings are supported scientifically and mathematically. The facts may be had free of charge by any American citizen who will address an inquiry to the Navy Department.

New Developments

The Naval Bureau of Yards and Docks has played an important part in the development and use of large cylinder piers for foundations of wharves, piers, etc., the use of heavy reinforced concrete quay walls and piers of the relieving platform type, and of sheet piling. The bureau has lately contrived and tested a composite pile—timber below and reinforced concrete above the mud-line—for pier and wharf construction, where piling of great length is required, where timber would be subject to attack and destruction by marine borers, and where added strength is also a vital element. This is not the hitherto known method of making up long pilings, but is distinctly a new development, and the lower concrete bands are placed by the aid of divers. It is believed that if aeronautical platforms are ever used far at sea, as is now being suggested, that they will be made up in this manner.

New Type Quay Wall

The navy has also recently completed at the Puget Sound Navy Yard a new type of reinforced concrete relieving-platform quay wall supported on piles, to meet special conditions due to great tidal ranges, with their attendant danger of unbalanced hydraulic pressure tending to overturn such works.

Concrete Conduits

It has been definitely found by this bureau that heat losses are cut practically to a percentage approximating one-fortieth of 1 per cent by the use of concrete subterranean conduits for passing steam through steam mains in the various navy yards. For this reason, the navy has had to take a step in advance of current industrial practice in some of its recent steam-distribution jobs. It has designed standard concrete conduits and in some cases tunnels for underground mains, and has placed them in operation with entirely satisfactory results. Such conduits have been found much more economical in operation and upkeep than the ordinary underground type, and they are greatly preferred to overhead construction. Where the initial expense is not too heavy, such conduit will be found decidedly beneficial at industrial plants.

Concrete in Sea Water

In addition to various engineering studies heretofore cited, the Bureau of Yards and Docks has made a number of important investigations and reports on the use of concrete in sea water, and has given assistance in studies of this very important problem conducted by others—notably in the case of the investigations of Messrs. Wig and Ferguson of the Bureau of Standards which were widely read and discussed by the engineering profession.

The Boston Navy Yard has also furnished place and physical conditions for an extensive test of reinforced concrete of various proportions and mixes to determine the action of sea exposure, wind, temperature and tide. Positive results of high value to the engineering profession and the maritime building trades have resulted.

Concrete Practice Improvements

The bureau recently prepared and dispatched a questionnaire, to all navy yards and stations, in order to gather data as a guide to further improvements in practice in the use of concrete for harbor structures. It is also experimenting with bituminous coatings for the protection of this increasingly important type of construction.

The navy's standards, upon which all its reinforced concrete structures are designed, and upon which all its concrete surfaces are painted or covered, represent the results of exhaustive study from the standpoints of theory and extensive practical application. These design standards indicate to designers and builders outside the government service the best principles and the most advanced practice in securing strength, safety, permanence, and at the same time true economy in this constantly broadening field of construction.

An article describing the construction of the Detroit-Canada Tunnel, now under construction, will be published in an early issue. This is an engineering project of special interest to the concretor.

Concrete for the Builder

A NEW DEPARTMENT

A FEW days ago a concrete builder came into the office. He had been given the job of building a concrete driveway over which heavy trucks would pass. Though he had done other concrete work, this was his first driveway job.

"You see," he said, "I want this driveway to stand up. It's the first job of this kind I ever had and it gives me a chance to build a reputation on this type of work. There are many places in my town where driveways ought to be built and if I do a darn good job on this one, I've got a good chance to build a lot more."

That man had the right idea. He appreciated that good work and selling go hand in hand. He knew that confidence in his work was an important sales help. It was the foundation upon which he expected to enlarge his business.

Another point is that this builder was alert to see new markets. He had studied his town and knew that more concrete drives were needed. Here was his opportunity for the present, at least. When the driveways are built, he will find other concrete jobs that need building. There are always new opportunities.

—‡—

THIS builder illustrates in a definite manner the object of this new department. It has a two-fold purpose, just as the builder had. First, it aims to point out new markets for the concretor. Second, it plans to tell him just how he can build those structures in such a manner that they will develop the confidence of the community in his work. A good job is any contractor's best advertisement. Without quality construction, selling is difficult and success in the long run is lost.

IT is true that in different communities different opportunities are found. In this man's town it happened to be driveways. In yours it may be sidewalks, or porches, or curb and gutter or rock gardens or wading pools or filling stations or any one of hundreds of possibilities.

The need is to size up your community and then start on the most logical market. Later other types of jobs will suggest themselves.

That is why all possible cases of concrete will be covered in this department. New suggestions will appear each month. Use them —and then tell us how you did it so that we can pass your experiences along to the other fellow, who, in turn, will tell you about the things that helped him.

—‡—

VISITS with concrete builders in the field indicate that they are very much in favor of the purpose of this department. Some of them are already applying merchandising methods and getting very good results.

What one contractor is doing in the way of advertising, sales letters, personal calls, etc., will be the subject of an article that will be published in next month's issue. The complete story of his campaign to place his services before his community will be given. Other builders will be able to use this as a basis for a similar campaign. It can be modified to meet your needs.

—‡—

OTHER material scheduled for future use includes such subjects as garages, industrial drives, stucco, plaster, color, basement and foundation construction, sidewalks, etc. The subject of winter construction will be covered in detail early enough to permit you to make the necessary plans to cash in on the coming winter's work.

Concrete for Permanence

The Making of a Watertight Paste

(Installment 3)

The Five Requirements for Durable Concrete. (Summarized from Installment No. 1 in the June issue):

1. Durable, impervious aggregates.
2. A watertight binding medium—the hardened cement-water paste.
3. A mixture that permits complete incorporation of the aggregates in the paste.
4. Methods of mixing and placing to secure a uniform homogeneous mass.
5. Adequate protection and curing.

By F. R. McMILLAN

IN the previous installment, test data were cited to show how both the quantity of mixing water and the extent of the curing affected the watertightness of concrete. In this installment, it is desired to identify these data more closely with the quality of the paste, for once the making of a watertight paste is clearly understood, the problem of producing watertight and durable concrete is greatly simplified.

For purpose of analysis, 5 concrete mixtures are represented in the lower diagram of Fig. 4. These mixes, with the water ratios indicated, gave slumps from 3 to 5 in., which is about as near a constant consistency as is possible with mixes of such varying cement content. The ordinates in this diagram represent the absolute volume of the ingredients in the unit volume of finished concrete. The 1:1:2 concrete, for example, is seen to consist of 66 per cent aggregate, 16 per cent cement, and 18 per cent total water, and the 1:3:6 concrete in the other end of the diagram, 76 per cent aggregate, 6.7 per cent cement, and 17.3 per cent total water.

In plotting these mixes, no allowance is made for air voids. For plastic mixtures, in which the ratio of coarse aggregate to fine aggregate is not less than about 1.5, the air voids should not exceed about 1 per cent. For non-plastic mixes (stiff or dry), the air voids may be very high and watertightness will then be difficult of attainment. For high ratios of sand to coarse aggregate, the air voids may be 4 per cent or higher, sufficient to modify watertightness somewhat.

The double crosshatched area in the diagram represents an assumed quantity of water which has gone into permanent combination with the cement, leaving the open area of the diagram to represent the water which remains in the mixture in a more or less free or uncombined state. It is upon the quantity of this uncombined water and its distribution through the mass that the permeability of the concrete must depend.

In the upper diagram of Fig. 4, the data from the lower diagram have been reproduced to represent only the quantity of paste. Thus, for the paste in the 1:1:2 concrete the entire ordinate is the upper 34 per cent from the lower diagram and for the 1:3:6, the entire ordinate is the upper 24 per cent from the lower diagram. Thus, we have in this upper diagram, a complete picture of the cement-water paste. The amount of uncombined water in this paste is dependent upon the extent to which the chemical reactions have progressed.

As pointed out in the second installment, the use of only sufficient water to meet the chemical requirements of combination would make the paste so stiff that it would not be useful in the ordinary concrete mixtures. Thus, of necessity, there is in any concrete mixture a certain amount of uncombined water. The problem, therefore, of making watertight paste consists in keeping the amount of this uncombined water within such limits that the space which it occupies is so finely divided and thoroughly dis-

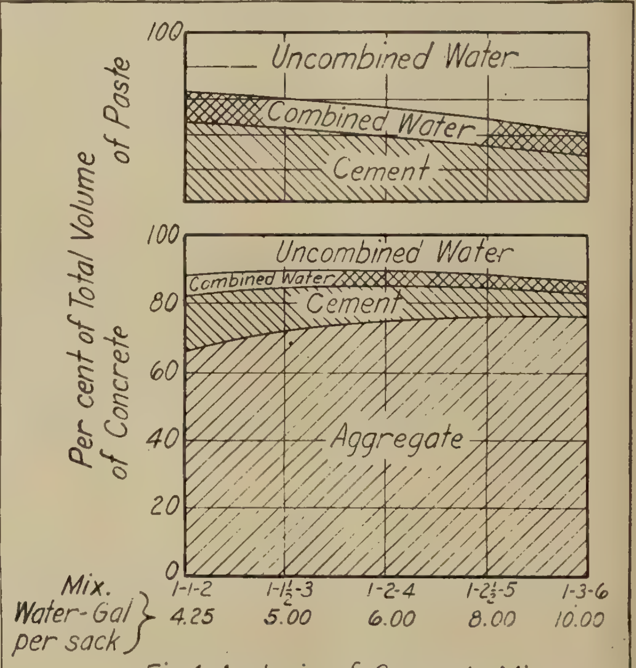


Fig.4 Analysis of Concrete Mixtures of Uniform Consistency (Slump 3-4 in.)

Figure 4

tributed through the paste that the water is easily held in the mass by capillary action. As the quantity of uncombined water in the paste increases, the quantity of cement reduces. Thus, not only is the total volume of pore space increased, but the size of the pores is increased in a higher ratio. It is this increase in size that has such an important effect on the permeability.

Control of the quantity of uncombined water can be had through two and only two means—the restriction of the quantity used in the mix (the water-cement ratio), and continued curing to force as much into combination as possible. The importance of both these factors can be easily visualized from the figure.

It can also be seen from the diagrams that there must be some quantity of cement below which watertight concrete cannot be expected. As the amount of combined water must be dependent upon the amount of cement, it is apparent that with a limited amount of cement in the paste, no amount of curing can reduce the amount of uncombined water to safe proportions for watertightness.

Value of Direct-by-Mail Advertising

Hints on Printed Salesmanship—Live Mailing Lists Very Essential—Sales Promotion Letters and Literature

DIRECT-MAIL advertising refers to all forms of printed matter which you address directly to the prospect. That is, instead of addressing the entire circulation of a newspaper or a magazine you pick out an individual and tell him your story.

There is every reason to believe that direct-mail advertising can be related by an increasing number of concrete contractors. While this particular article will be devoted to the high points that will enable a builder to plan a direct-mail campaign, a complete story of how one firm profited by direct-mail and other advertising will be published in *Concrete for the Builder* in the September issue.

Every district offers a different sales problem but there are in general certain groups which should receive advertising literature in addition to personal calls by your salesmen. Your mailing and call list should include architects, members of building departments, speculative builders, realtors, leading farmers, citizens for whom you have done concrete work, banks, mortgage companies and building and loan associations. It is especially important that contractors engaged in stucco work should contact the financial institutions just mentioned to sell them on the idea of permanent wall surfacing materials.

Building Up a Mailing List

To prepare a special mailing piece for each group would in most cases be prohibitive, so the advertising should be prepared in a style that will appeal to all groups. Every concrete job you build offers an opportunity for an effective mailing piece. Mailing pieces, however, will be discussed after the method of building up a mailing list is described.

The mailing list is the key to successful direct-by-mail advertising. If the person to whom the literature is sent is not a prospect, or has moved, no amount of direct-mail advertising will produce results. Everyone on the list should be a real prospect. Postmasters will check the addresses for a very nominal fee but only regular visits by you or your salesmen will determine whether or not there is any business in view. Certainly if a man is worth keeping on a mailing list he is worth at least two calls a year.

There are various sources for a prospect list, but the following are listed as a guide:

Architects—Local directories, commercial clubs, building permits.

Speculative Builders—Local directories, builders' organizations, commercial clubs, advertisements, state banks, mortgage companies, building and loan associations.

Prospective Builders—Real estate organizations, financial organizations, builders' organizations, building page reviews, marriage licenses, building permits, building contractors who do not do concrete work.

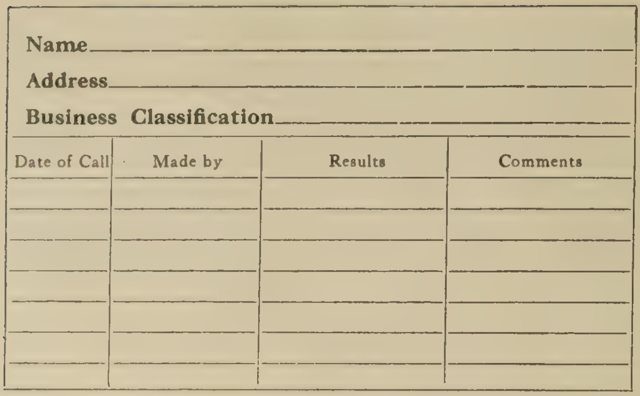
Realtors—Local directories, real estate organizations, commercial clubs, advertisements, building page reviews.

Leading Farmers—County agents and other agricultural extension workers or organizations, farmers' organizations.

Banks, Mortgage Companies and Building and Loan Associations—Local directories, advertisements, builders' organizations, building page reviews.

A Record Card Is Helpful

In view of the fact that a live mailing list is essential, a permanent, usable file should be developed. A 3- by 5-in. card can be cheaply printed to provide a permanent record for the prospect's name, address and salesman's record. This report should be made after every call, giving information concerning the status of the customer or prospect, and the progress the salesman made with him. When the address changes a new card should be filled out and the old one placed in a separate file. As a suggestion, printing should include three rulings across the top of the card, each headed with "Name," "Address," and "Business Classification," in that order. The remainder of the card should be divided into four vertical columns, each headed, "Date of Call," "Made by," "Results," and "Comments," in that order. Horizontal lines



Name__________

Address__________

Business Classification__________

Date of Call	Made by	Results	Comments

The prospect record card imprinted as suggested

can be printed across the card to simplify filling in of information from time to time. All actual orders for concrete work should be listed under "Results," while information on methods of approach, etc., should be included under "Comments" for salesmen to follow up.

A number of builders have found direct-mail advertising to be especially effective in backing up the work of new salesmen. Where the contractor handles the selling himself direct-mail will be equally effective. By using printed pieces the contractor can be certain that the prospect has been told the complete story, varied in order to emphasize the strong selling points. When a new sales area is being opened or a contractor is using direct-mail for the first time, it is more economical to use a series of three or four mailings to tell the story to "cold" prospects. When the mailings are followed by a personal call —and this is a very important part of successful merchandising—the main story has been told and the salesman presents only a summary, closely tied in with the selling stories delivered by the postman.

Direct Mail Advertising

The most common forms of direct advertising are letters, illustrated letters, folders, broadsides and booklets. Letters are the most personal form of direct advertising and the selling story is easier to put across because there is no other reading matter to distract the readers' attention. To bring the results the letter must have individuality and should have a strong first paragraph which will catch the reader's interest and induce him to read the sales story. Put the "you" and "your" spirit into the letter and talk of "your need," "your comfort," "your investment" and so on. Above all, make the emphatic sales arguments ring true. If the letter is one that urges action make it easy for the reader to act. Enclose a reply card; invite him to answer on the back of your letter; print a return blank on the bottom of the letter; or even suggest that the reader telephone the office immediately.

The illustrated letter made up as a 4-page folder—a double sheet folded once—has grown in favor during recent years. Page 1 is used for a letter message. Pages 2, 3 and sometimes 4 are used to carry the main sales story with suitable illustrations. If desirable, the folder may be folded three times and used as a self-mailing piece. This form of advertising combines the advantages of a personal letter and the regular folder and serves as a tie-up between them. A number of aggressive advertisers are using the illustrated 4-page letter to replace heavier and more expensive literature.

The usual folder is made up of a varying number of pages and carries no personal letter. It is advertising copy from first to last and is commonly used in the self-mailing form to reduce the mailing cost. Since no fill-in of the prospect's name and address is required, this form is often cheaper than the illustrated letter.

Broadsides are large sheets approaching the size of a newspaper page printed in suitable colors and carrying a smashing sales story exploiting some advantage that can be presented in poster style. For example, one broadside could be devoted to concrete walks and driveways built by a contractor in a large housing development. This could show illustrations of the outstanding jobs and tell how the concrete improvements helped sell the houses.

Booklets are rather expensive, but many builders profit by using them. A booklet could include, for example, a record of one year's work in concrete depicting typical or outstanding examples of construction work.

A contractor may hesitate to use direct-mail advertising if it is already being used by a competitor in the same field. This hesitancy is not justified in most cases. Mechanical refrigeration or oil heating becomes a more impressive convenience after the householder receives a folder from a third or fourth dealer than after he receives the first one. This is just as true in the concrete contractor field.

A well planned direct-mail campaign, with the literature sent to a select list of live prospects, combined with personal calls by aggressive, well-trained salesmen, will aid in putting concrete improvements in the home or whatever field the builder has in mind. By keeping constantly at the job of advertising the building public will finally be educated to buy concrete in the various forms sold by the builders.

Workmen's Costumes Keep Contractor's Name Before Public

Although caps and gowns are usually reserved for the June graduates of colleges and universities, A. Artioli & Sons, concrete contractors of Springfield, Massachusetts, have found a use for caps and a semblance of gowns in advertising their services to the building and concrete-buying public.

Every workmen employed by this firm wears an orange cap imprinted with the name of the company in large, legible black letters. Likewise, the men's work shirts have the company's trade mark displayed on the back. These uniforms must be worn while the men are on the job.

A. Artioli & Sons do not confine their "display advertising" to caps and shirts, however. Coupled with job signs, truck signs, and signs on the tool boxes, the signs on the caps and shirts identify every job as an "Artioli Job." The senior member of the firm states that a great deal of the work that comes to the company results from keeping his name before the public in the various ways mentioned.

Demand for Highway Refreshment Stand Structures Merits Attention

Like the filling station, the popular wayside "barbecue" stand opens another opportunity to the concrete builder since there is a growing demand by owners for permanent, attractive structures.

The National Stand Owners' Association, an organization of road refreshment stand owners, have voted to support a movement to beautify and sanitate their stands.

The records of the association show that more than 110,000 stands were doing business in 1928 and the sales total for 1929 is expected to reach the half-billion mark.

How to Build

Ribbed Type Reinforced Concrete Floors

Helpful Information for the Builder Including Design Data, Hints on Form Construction and Correct Method of Reinforcing

A RIBBED floor consists of parallel reinforced concrete joists, placed on about 24- to 30-in. centers, which support a concrete deck or top that is usually from 2 to 3 in. thick. The concrete for the joists and top is placed in one operation, and the construction becomes monolithic. When the ribbed floor is built a minimum amount of material is required.

Practically all of the general construction information given in the article, "How to Build Solid Slab Reinforced Concrete Floors," published in the July issue, will be helpful to the builder of ribbed type reinforced concrete floors. The sections on form construction; lumber for form work; conduits, pipes and openings; foundation walls and footings; air space insulation; concrete for floors, beams and columns; placing concrete in forms; removal of forms; replacing of supports and shores, and curing concrete floors, included essential information that applies to the construction of ribbed floors as well as the solid slab type.

Design Table

Table 4 gives information for designing a ribbed concrete floor suitable for residences or small buildings. The safe superimposed loads given are for ribbed slabs simply supported. If it is desired to increase the safe loads for use with restrained or continuous spans, investigation must be made of shear and bond stresses. One-half of the bars in each joist shall be bent up as shown in the typical longitudinal section for ribbed concrete residence floors. Shearing stresses have been based on the use of tapered end forms, although these are not shown in the drawing. Tapered end forms increase the width of the joists 5 in. at the supports.

Placing concrete for ribbed floor. Pipes are installed and forms provided for the necessary openings in the slab

Engineers using Table 4 should refer to the 1928 Building Regulations of the American Concrete Institute for conditions governing moment co-efficients.

The following technical notes refer to Table 4, and contain information that will be helpful to the designer:

RIBBED SLABS

Table 4. Spans simply supported, B.M. $= Wl^2/8$

$f_c = 800$ lbs. per sq. in., $f_s = 20{,}000$ lbs. per sq. in., $n = 15$

Joist and Top					Safe Superimposed Load in Lbs. Per Sq. Ft. for Following Spans									
Depth, In.	Width, In.	Spacing, In.	Weight Per Sq. Ft. Lbs.	Reinforcing Steel	10	12	14	16	18	20	22	24	26	28
6–2	4	24	38	2——¾″ ϕ	180	144	117	96	68	48	----	----	----	----
				2——⅝″ ϕ	150	119	84	55	----	----	----	----	----	----
				2——½″ ϕ	118	74	44	----	----	----	----	----	----	----
8–2.5	5	25	52	2—— 1″ ϕ	----	----	----	184	157	136	113	86	66	50
				2——⅞″ ϕ	----	----	194	164	140	104	76	56	40	----
				2——¾″ ϕ	----	203	166	126	88	60	41	----	----	----
6–2.5	5	35	42	2—— 1″ ϕ	----	----	110	91	76	82	50	----	----	----
				2——⅞″ ϕ	----	118	95	78	64	45	----	----	----	----
				2——¾″ ϕ	128	100	80	54	----	----	----	----	----	----
8–2.5	8	38	52	4——⅞″ ϕ	----	----	----	192	164	143	120	91	70	54
				4——¾″ ϕ	----	----	230	187	137	101	74	54	----	----
				4——⅝″ ϕ	----	228	172	119	83	58	39	----	----	----

Loads: The safe superimposed loads in pounds per square foot given in Table 4 are based on the controlling safe loads as determined by bond, shear or bending. The dead weight of the structural slab only has been deducted from the total safe loads and the weights of surfacing, partitions and plaster shall be deducted from the figures given to obtain the safe live-loads. The live-load recommended by the Building Code Committee of the United States Department of Commerce is 30 lbs. per sq. ft. for residence floors of monolithic reinforced concrete construction.

Working Stresses: Working stresses are those recommended by the 1928 Building Regulations of the American Concrete Institute for 2,000-lb. concrete—7½ gal. of water (total) per sack of cement—and intermediate grade billet or rail steel.

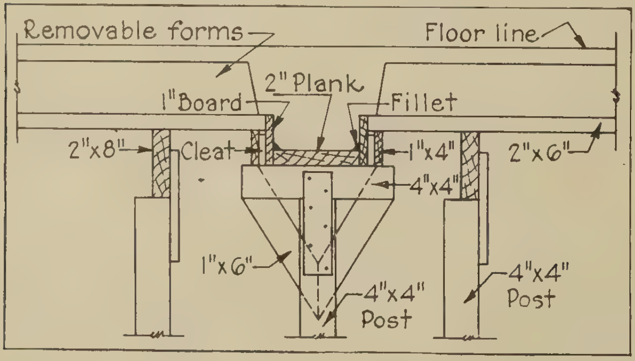
Reinforcing and Temperature Steel: Reinforcing and temperature steel shall be placed properly as shown in the typical longitudinal section and securely wired. In all slabs ¼-in. round bars shall be placed on not more than 12-in. centers normal (at right angles) to the main reinforcement. Welded steel fabric of equivalent effective area may be substituted for the ¼-in. round bars. To further minimize the effect of shrinkage and temperature the recommendations of the 1928 Building Regulations of the American Concrete Institute should be followed.

Anchorage: Longitudinal steel shall be hooked at the supports or extended into the adjoining spans as shown in the typical longitudinal section to provide special anchorage.

Construction Details

In the drawing of the ribbed concrete residence floor are shown typical construction details. In this design the unsupported span is limited to 16 ft. Where longer spans are built supports are required and these may be bearing walls or reinforced concrete beams as shown in the typical longitudinal section. Also, a bearing wall or beam is required under any first floor partition which carries a load from the second floor. If bearing walls or beams are required as supports in the construction, the walls or the forms for concrete beams should be built before any forming is done for the ribbed floor itself.

Form work for a reinforced concrete beam as used with forming for ribbed floor construction is shown in an accompanying drawing. Typical column forms were discussed in the previous article, "How to Build Solid Slab Reinforced Concrete Floors," and this same type of column can be used to support a beam under a ribbed floor.



Cross-section of beam form for ribbed floor construction

Following construction of the supporting walls or forms for beams as the case may be, posts and stringers for carrying the open centering, are erected. Open centering is the framework of planks which supports the removable forms. Removable forms of metal or wood, over which the concrete is placed to form the joists and the top slab or deck, are supported by 2- by 6-in. planks as shown in the form detail drawing.

Standard sized metal forms or wood boxes of similar design are used. Posts of 4- by 4-in. stock and 2- by 8-in. stringers support the 2- by 6-in. planks. The maximum spacing of posts for an 8-in. ribbed floor is 6 ft. 6 in. The 4- by 4-in. posts are supported on planks usually of 2- by 10-in. stock, to prevent settling. Hardwood wedges are placed between the base of each post and the plank so that any difference in level may be corrected by adjusting these wedges.

For most spans in residence construction, the 2- by 6-in. planks which support the removable forms and form the joist bottoms are spaced 24 in. on center. Stringers which support these planks are spaced 4 ft. apart. Removable forms are lined up with the hollow space down and with sufficient space between rows to permit forming of joists 4 in. wide at the bottom.

Open-centering, the framework which supports removable forms used in building ribbed floor

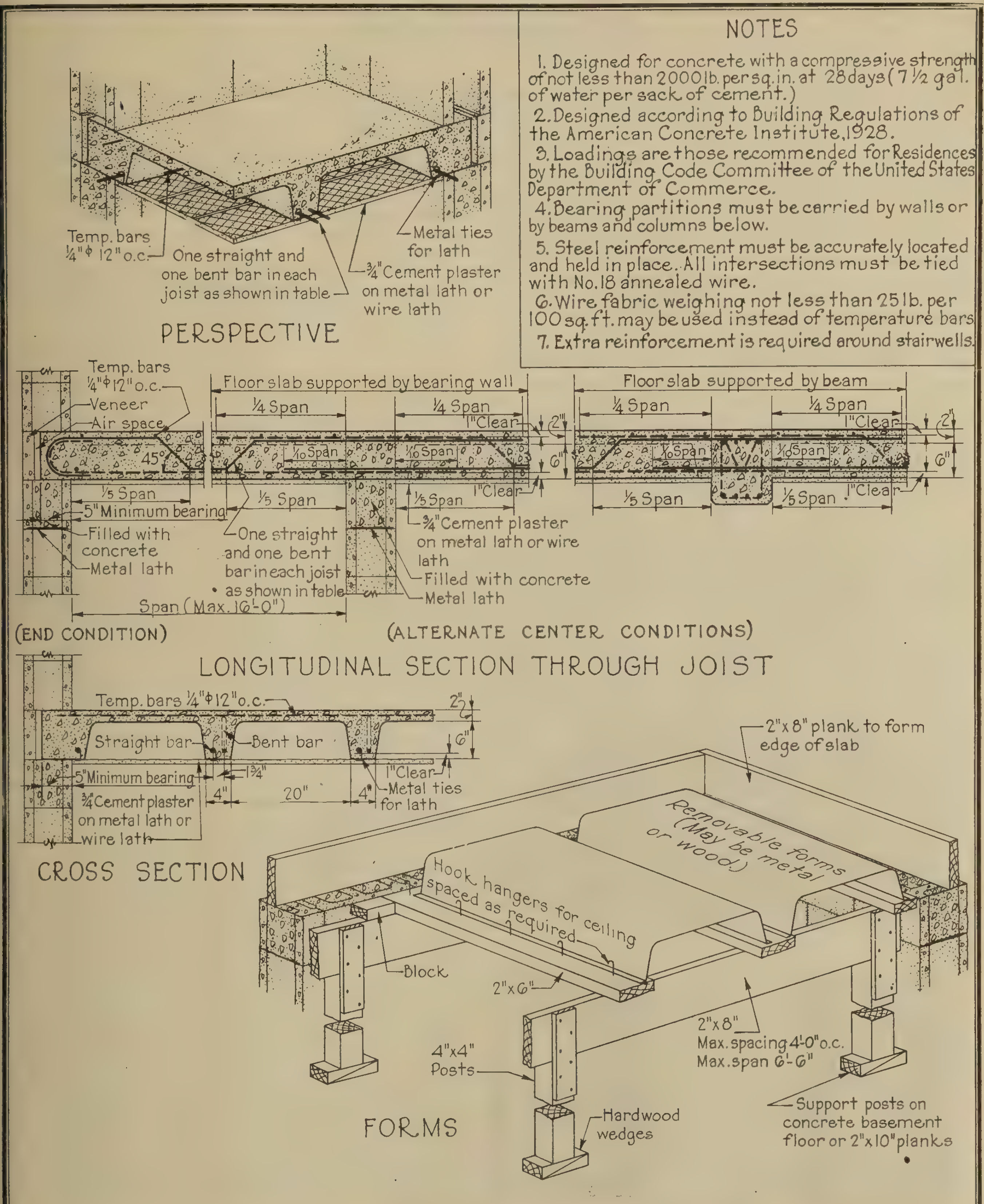
In the space between the rows of removable forms, the main reinforcing steel is placed. The size of the steel for different floor spans is indicated in Table 4. Two bars are used in each joist, one being bent up 45 degrees, as shown in the longitudinal section and the other remaining straight. The bars should be supported 1 in. above the plank and ¾-in. from the removable forms on chairs or small pieces of concrete. The ends of the bars are bent so that they are at least 1 in. from the top, bottom and edge of the slab, as shown in the longitudinal section. This covering of concrete gives the steel protection against possible corrosion or fire. Conduits or pipes are installed or openings provided for them in the floor slab after the main reinforcing has been placed in joist forms.

As stated in the notes pertaining to Table 4, ¼-in. round bar reinforcement on not more than 12-in. centers or welded steel fabric of equivalent effective area is laid in the top part of the slab, ¾-in. below the surface, when the concrete is placed. Temperature reinforcement, as this is commonly called, is always placed at right angles to the main reinforcing steel; in this case, at right angles to the joists.

Basement Ceilings

Where plastered basement ceilings are desired, metal lath or wire lath is attached to the under side of the floor by wire ties fastened around the reinforcing and extended through holes in the planks forming the joist bottoms. Nails, driven into the planks so that the heads will be embedded in the concrete, are sometimes used as hangers for the lath.

Designing, mixing, placing and curing of concrete and the removal of forms were discussed in the previous article, "How to Build Solid Slab Reinforced Concrete Floors." The same information applies to ribbed floor construction.



NOTES

1. Designed for concrete with a compressive strength of not less than 2000 lb. per sq. in. at 28 days (7½ gal. of water per sack of cement.)
2. Designed according to Building Regulations of the American Concrete Institute, 1928.
3. Loadings are those recommended for Residences by the Building Code Committee of the United States Department of Commerce.
4. Bearing partitions must be carried by walls or by beams and columns below.
5. Steel reinforcement must be accurately located and held in place. All intersections must be tied with No. 18 annealed wire.
6. Wire fabric weighing not less than 25 lb. per 100 sq. ft. may be used instead of temperature bars.
7. Extra reinforcement is required around stairwells.

Temp. bars ¼"Φ 12" o.c.
One straight and one bent bar in each joist as shown in table
Metal ties for lath
¾" Cement plaster on metal lath or wire lath
PERSPECTIVE
Temp. bars ¼"Φ12" o.c.
Veneer
Air space
45°
⅕ Span
5" Minimum bearing
Filled with concrete
Metal lath
Floor slab supported by bearing wall
¼ Span
¼ Span
1" Clear
2"
6"
1/10 Span
1/10 Span
⅕ Span
⅕ Span
1" Clear
One straight and one bent bar in each joist as shown in table
¾" Cement plaster on metal lath or wire lath
Filled with concrete
Metal lath
Span (Max. 16'-0")
Floor slab supported by beam
¼ Span
¼ Span
1" Clear
2"
6"
1/10 Span
1/10 Span
⅕ Span
⅕ Span
1" Clear
(END CONDITION)
(ALTERNATE CENTER CONDITIONS)
LONGITUDINAL SECTION THROUGH JOIST
Temp. bars ¼"Φ12" o.c.
2"
Straight bar
Bent bar
6"
5" Minimum bearing
1¾"
1" Clear
4"
20"
4"
Metal ties for lath
¾ Cement plaster on metal lath or wire lath
CROSS SECTION
2"x8" plank to form edge of slab
Removable forms (May be metal or wood)
Hook hangers for ceiling spaced as required
Block
2"x6"
2"x8" Max. spacing 4'-0" o.c. Max. span 6'-6"
4"x4" Posts
Hardwood wedges
Support posts on concrete basement floor or 2"x10" planks
FORMS

RIBBED CONCRETE RESIDENCE FLOOR

Pre-Selling Brings Results

J. E. Noelp Cement Company, Columbus, Ohio, Pre-Sells With Printed Pamphlet

THE J. E. Noelp Cement Company, of Columbus, Ohio, is a firm believer in pre-selling and the use of the printed word for this purpose.

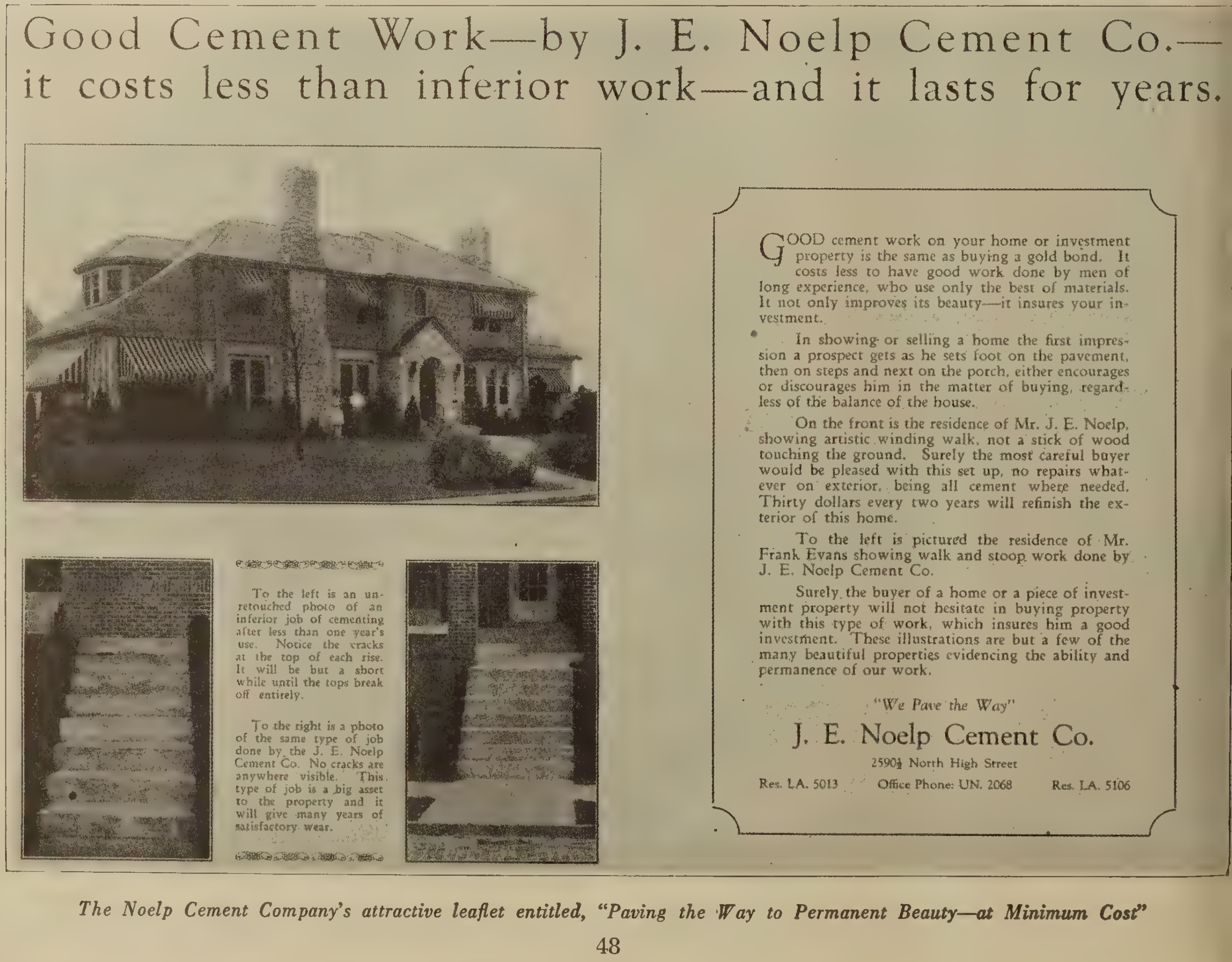
Using the slogan, "We Pave the Way," this company merchandises concrete construction for sidewalks, alleys, driveways, foundations, basement and residence floors, porch floors, steps, curb and gutters, and tennis courts. In order to pre-sell speculative builders, general contractors and realtors on the idea of permanent concrete improvements an attractive printed circular is used. The inside pages of this four-page publication are shown in the accompanying illustration.

The title of this leaflet is "Paving the Way to Permanent Beauty—at Minimum Cost." This contractor appears to be proud of his work and this is rightly so, for there are countless examples of good concrete construction built by him in Columbus. That the business has also been successful is evidenced by the photograph of an attractive residence pictured in the inside pages of the circular. By merchandising concrete, Mr. Noelp was able to provide the home surroundings shown in his circular for his family.

Pre-selling is only part of Mr. Noelp's merchandising campaign. He has organized a crew that is capable of handling various kinds of work without his personal guidance on every job. As a result, he is able to get out and meet the consumers of concrete. He makes personal calls—calls that bring results. He contacts persons who are in close touch with building operations in the residential field. This aggressive selling combined with a record for placing good concrete jobs have built up a good business.

Use Job and Truck Signs

Other forms of advertising used by the J. E. Noelp Cement Company are job signs which identify the company with every project and truck signs which show that the company is well equipped to handle any job. It is certain that the name of this concrete contractor is well known in Columbus, Ohio.



Good Cement Work—by J. E. Noelp Cement Co.—it costs less than inferior work—and it lasts for years.

To the left is an unretouched photo of an inferior job of cementing after less than one year's use. Notice the cracks at the top of each rise. It will be but a short while until the tops break off entirely.

To the right is a photo of the same type of job done by the J. E. Noelp Cement Co. No cracks are anywhere visible. This type of job is a big asset to the property and it will give many years of satisfactory wear.

GOOD cement work on your home or investment property is the same as buying a gold bond. It costs less to have good work done by men of long experience, who use only the best of materials. It not only improves its beauty—it insures your investment.

In showing or selling a home the first impression a prospect gets as he sets foot on the pavement, then on steps and next on the porch, either encourages or discourages him in the matter of buying, regardless of the balance of the house.

On the front is the residence of Mr. J. E. Noelp, showing artistic winding walk, not a stick of wood touching the ground. Surely the most careful buyer would be pleased with this set up, no repairs whatever on exterior, being all cement where needed. Thirty dollars every two years will refinish the exterior of this home.

To the left is pictured the residence of Mr. Frank Evans showing walk and stoop work done by J. E. Noelp Cement Co.

Surely the buyer of a home or a piece of investment property will not hesitate in buying property with this type of work, which insures him a good investment. These illustrations are but a few of the many beautiful properties evidencing the ability and permanence of our work.

"We Pave the Way"

J. E. Noelp Cement Co.

2590½ North High Street

Res. LA. 5013 Office Phone: UN. 2068 Res. LA. 5106

The Noelp Cement Company's attractive leaflet entitled, "Paving the Way to Permanent Beauty—at Minimum Cost"

Modern Stucco and Plaster

A Discussion of Standard Practice in Application of Portland Cement Stucco and Plaster

Editor's Note: This is the first of a series of five articles on the latest developments in approved plastering practice. The facts presented are based on practical experience and laboratory investigations and bear the endorsement of men prominent in the plastering industry.

Installment I

PLASTERING is one of the oldest arts. Its purpose in early days was that of filling the cracks in walls to make them weathertight. The "wattle and daub" or mud plastering of the ancient Briton is an example of this early use of plaster. With the development of the art, however, portland cement stucco, a highly durable plastering material, came into wide use. As its decorative possibilities became better known there developed a popular demand for new and unusual effects. To produce these, plastering materials of better spreading quality were required. This led to the use of admixtures.

Plasterers soon learned that materials having extreme spreading qualities usually were less durable. To correct this it was necessary to develop a product that would endure, yet be plastic enough to permit a wide range of artistic finishes. Experiments with portland cement stucco on the scaffold and in the laboratory have provided a wall covering which satisfies both the requirements of durability and satisfactory appearance. Facts brought out in these experiments furnish the basis for these articles which present the latest practices in the use of portland cement stucco and plaster. They are durable—age increases their strength and density. They do not cause colors to fade nor metals to rust. They resist fire. They have sufficient plasticity and harden slowly enough to let workmen produce a variety of textures. All these desirable qualities are obtained at moderate cost.

Pleasing results may be secured by the use of portland cement stucco in residential construction. This Flint, Mich., structure is an excellent example

The principal materials in portland cement stucco are portland cement, aggregate and water. Other materials are added as required, such as (1) mineral pigments for producing colored finish coats, (2) hair or fiber for use in the scratch coat mortar on back-plastered construction, and (3) plasticity materials when increased workability is desired.

Aggregate. Aggregate should be clean sand, screenings from crushed stone, or a mixture of these properly graded from fine to coarse. All aggregate for the base coats (scratch and brown) should pass the No. 8 sieve with approximately 5 per cent passing the 100-mesh sieve. For the finish coat the fineness limit remains the same but it may be desirable to have less coarse material. The exact grading is governed by the type of finish desired. For some finishes the aggregate is limited to material passing the No. 14 sieve, while for others requiring less plasticity, materials that have up to 15 per cent retained on the No. 14 sieve are suitable. All aggregate must be free from loam, silt and vegetable matter.

Method of Sand Testing

Sand may be tested for silt as follows. Pour sand into a 32-ounce graduated bottle to the level of the 14-ounce mark and add water to the 28-ounce mark. Shake vigorously for a minute and allow to settle for one hour. If one ounce or more of sediment appears above the sand it is not suitable for use in stucco.

Here is a simple test to find out if the sand contains vegetable matter. An ordinary 12-ounce prescription bottle is filled to the 4½-ounce mark with a sample of sand. A 3 per cent solution of caustic soda* (sodium hydroxide) is added until the 7-ounce mark is reached. The contents are shaken thoroughly and then allowed to stand 24 hours. The color of the liquid will indicate whether the sand contains dangerous amounts of vegetable matter. A clear or light-colored liquid shows the absence of vegetable matter. A light straw color shows the presence of some organic matter but not enough to be harmful. Dark color means the sand contains injurious amounts and should not be used.

Plasticity Agents. Materials passing the 100-mesh sieve (excepting cement) are referred to as "plasticity agents," "lubricators," or "fatteners," and are used to increase workability. Aggregate material passing the 100-mesh sieve, hydrated lime, diatomaceous earths, finely divided clays, and asbestos fiber are common plasticity agents. These materials should be of the highest quality and should not be added in excess of the amounts given in the following section on "Proportioning and Mixing." Excessive amounts are objectionable in that they reduce strength and increase porosity.

Water. Only water that is fit to drink should be used in mixing stucco. It should be free from oil, acid, alkali and vegetable matter.

Mineral Pigments. Only high-grade mineral pigments should be used for coloring stucco. Such pigments have the highest color values and are most economical since less pigment is required to produce a desired effect. Aniline base colors and other organic or vegetable dyes should not be used as they are likely to fade.

Mixing of pigments in finish coat materials should be resorted to on the job only when factory-made portland cement stucco is not available. In a factory-made product, pigments and cement are first ground together and then mixed thoroughly with the aggregate in special machine mixers. It is possible under these conditions to attain accuracy in measurement and thoroughness in mixing which ordinarily cannot be approached on the job.

In the event that factory-made portland cement stucco is not available, the use of colored cement will be found advisable. With colored cement the difficult operation of mixing the pigments and the cement on the job is eliminated. If colored cement is not obtainable, then it will be necessary to mix the cement and mineral pigment on the job, in which case it is recommended that a ball mill be used for the purpose. A general guide for the selection of color is given in the accompanying table. Correct proportions of cement and pigment are determined by trial as explained under "Proportioning and Mixing."

COLORING MATERIALS

A general guide for the selection of coloring materials follows:

For *brown*, use burnt umber or brown oxide of iron. Yellow oxide of iron may be added to obtain modification of this color.

For *buff*, use yellow ochre or yellow oxide of iron. Red oxide of iron may be added in limited quantities.

For *gray*, use small quantities of black iron oxide, manganese black or Germantown lampblack.

For *green*, use chromium oxide. Yellow oxide of iron may be added.

For *pink*, use small quantity of red oxide of iron.

For *rose*, use red oxide of iron.

For *cream*, use yellow oxide of iron in small quantities.

For *white*, use white portland cement.

Proportioning and Mixing

Base coats (scratch and brown) should be made of part portland cement and 3 parts aggregate. Material meeting the specifications already described should b used. If a plasticity agent is required, as discussed earlie in this article, use not to exceed 10 lbs. of hydrated lim per sack of cement. If other lubricators are employed, us smaller amounts (about 2 to 3 lbs.). For job-mixed finis coats, approximately the same proportions are used a for the base coats.

Proper proportions of mineral pigments in finish coa stucco should be determined by experiment. In genera the amount of coloring materials should not exceed 6 pe cent of the weight of the cement. White finishes are obtained by using white portland cement and light-colore aggregate. A general guide to the selection of minera pigments to obtain the various color effects commonl used in portland cement stucco, such as gray, green, buf brown and others, is given in the table under the heading "Coloring Materials."

Measurements of materials must be accurate and al batches proportioned exactly alike. Because variations i the moisture content of the aggregate cause change in volume due to bulking, aggregate of uniform moisture content should be used throughout the job to insure accurat measurements.

Materials should be mixed to a uniform color befor water is added and then wet-mixed to the desired consistency. Thorough mixing is absolutely essential. Hand mixing is satisfactory if done thoroughly, but machin mixing usually gives greater uniformity. The mixe should be run at least five minutes after all ingredient are placed in the drum. In the case of hand-mixing, th batch should be hoed back and forth in the box 10 to 1 minutes after the water has been added.

Portland cement stucco is not injured by standing 2½ to 3 hours if remixed frequently without adding water No mortar should be used after it has set up or hardene to such an extent that water must be added to make i workable. Admixtures to hasten set should not be used

* * *

Installment II, which will appear in the September issu will deal with "Bases for Portland Cement Stucco."

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*A 3 per cent solution of caustic soda may be made by dissolving one ounce of sodium hydroxide in a quart of water. Keep the solution in a glass bottle tightly corked. Handling sodium hydroxide with moist hands may result in serious burns. It is also injurious to clothing and leather. Any druggist can make the correct solution for you.

New Work for the Contractor—

Concrete for the Public Park

NEARLY every community, regardless of size, has set aside a plot of ground for park purposes. The plot may be only a small area surrounding the court house or city hall, or it may be an extensive tract covering hundreds of acres. Whatever the size, it remains a place set apart where one may feel free to relax and enjoy the beauties of nature. The park may also provide a place for outdoor recreation such as golf, tennis, swimming and the many other athletic activities which are prominent in every-day American life.

It is the purpose of this brief story to point out the many uses of concrete in public parks and to discuss the best methods for developing and selling this market. You can increase your business in this field by demonstrating that concrete structures, effectively designed, harmonize readily with the artistic treatment of park areas and being highly durable, aid in preserving the beauty of such public improvements.

AS in any sales plan, the first move should be a thorough study of your market. Prepare a list of the possible uses of concrete in the park and recreational areas. Here are a few:

- Entrances
- Fountains
- Benches
- Wading Pools
- Picnic Tables
- Stadiums
- Bandstands
- Animal Pits
- Tennis Courts
- Swimming Pools
- Handball Courts
- Walks and Steps
- Curbs and Gutters
- Pavilions

Walk through your local parks and prepare a list of the present uses of concrete and also a list of structures which could be built of concrete to add to the usefulness

* * *

Shuffleboard courts have lately been placed in a number of parks. Why not build some in your town?

* * *

of these recreational areas. By observing the people who use the parks and talking with them, determine which concrete improvements are needed or wanted and then promote the park board or commissioners to have them built.

What One Builder Did

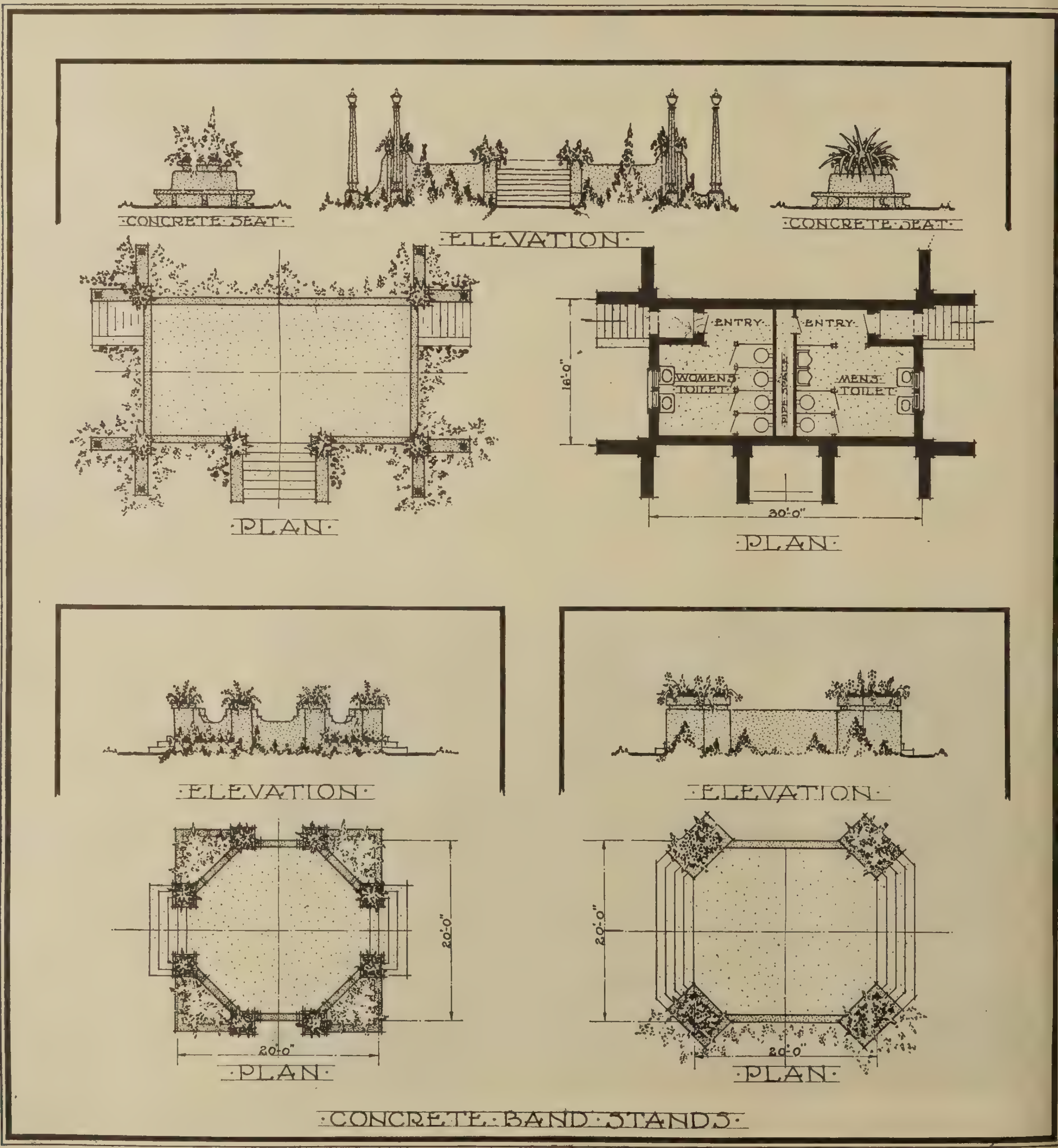
An illustration taken from a town of about 15,000 will illustrate the sales plan. Our contractor friend got the idea from his son. What the park needed was a wading pool. Before it could be built the park board had to be sold on the idea.

This contractor knew that the superintendent of the park board was anxious to make a good showing during his term of office. He knew also that this man possessed first-hand information about the needs of the local parks and the wishes of the people for additional improvements.

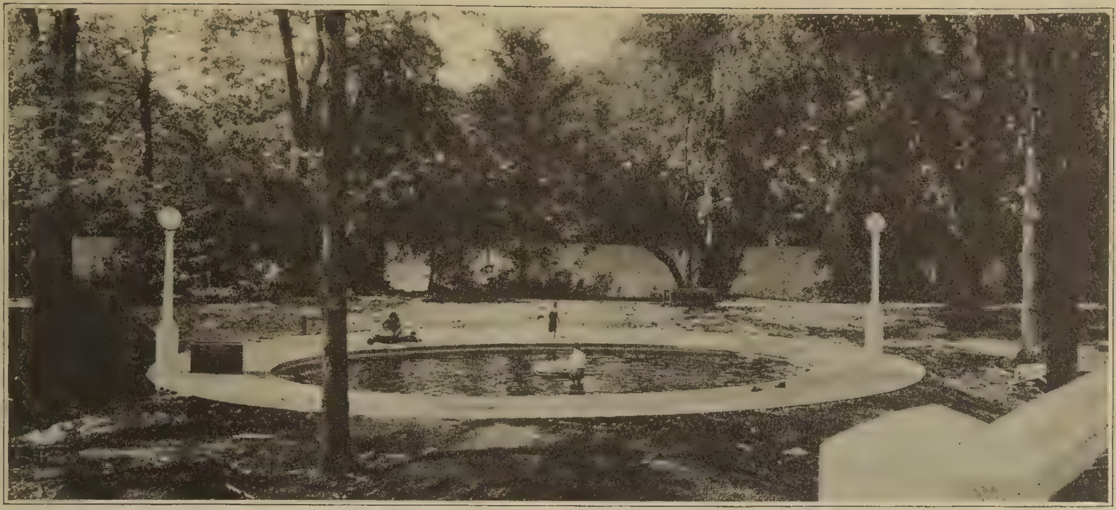
The contractor talked wading pools to his neighbor and asked them to tell the superintendent how nice i would be to have a wading pool in the park in which the children could splash and play without danger. A rea hot spell added impetus to the promotion and the superintendent received numerous requests for a wading pool

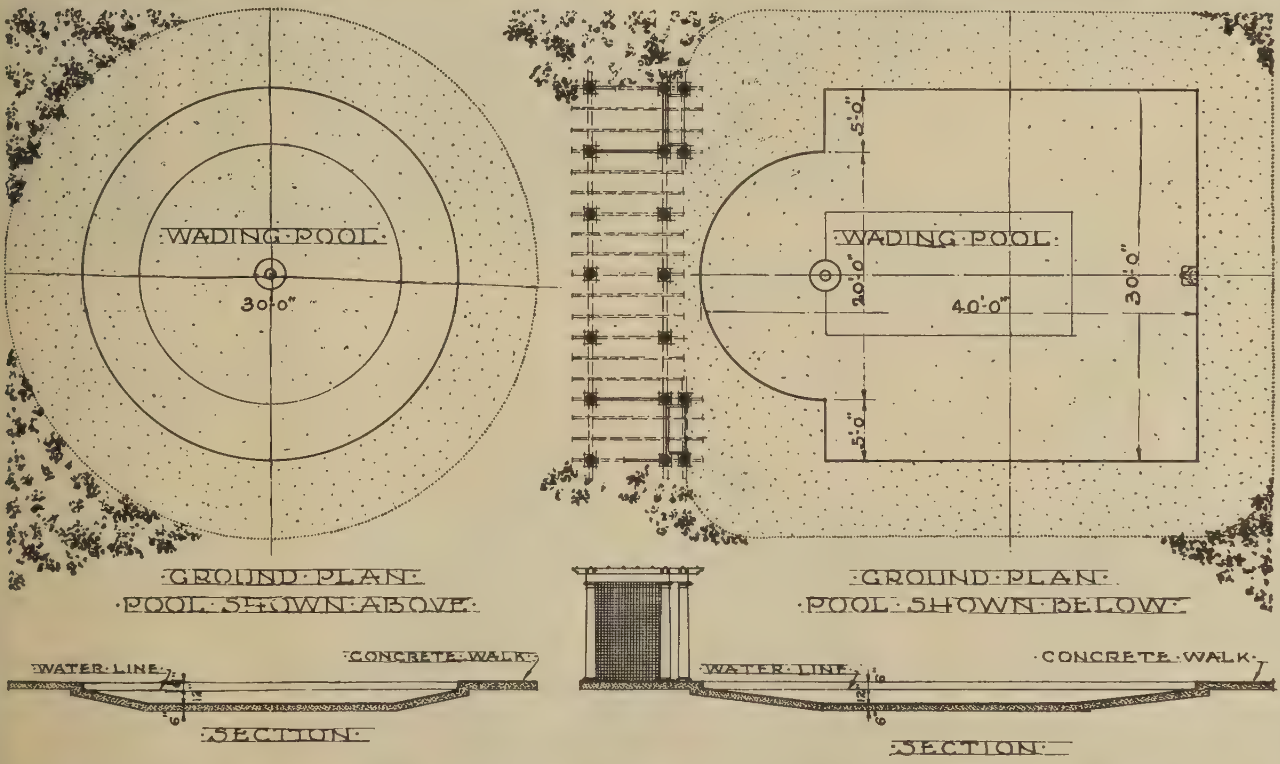
The job was really half sold before the contractor calle on the park official. When the contractor visited the superintendent, he discussed the usefulness of a wading pool stating it would cause more parents to take their childre on outings to the park. He also told how it would hel keep the children off the streets during the long summe vacation. The closing argument was that the citizen would be pleased, since the success of a park is largel measured by the number of people that it attracts.

The superintendent admitted that it would be a worth

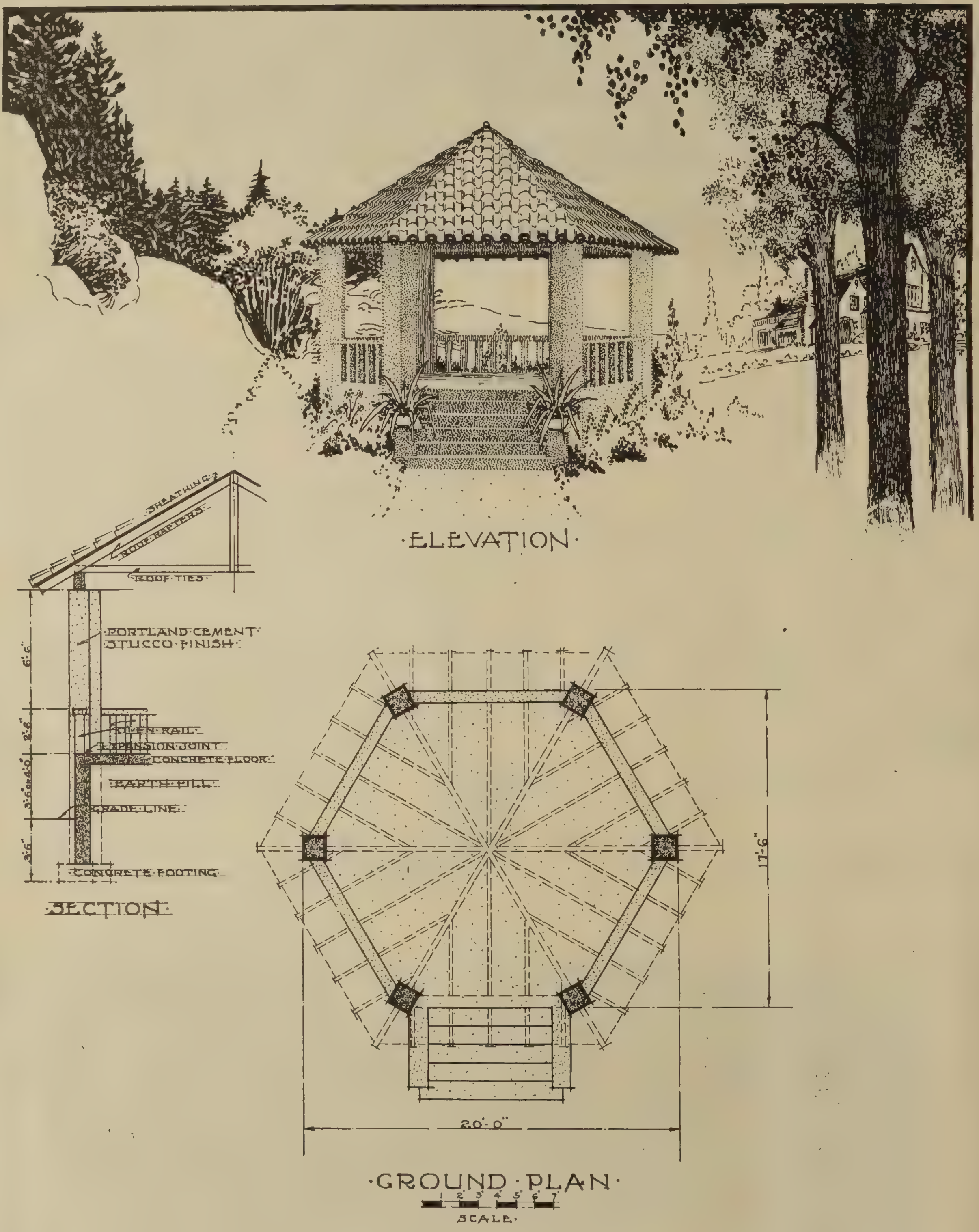


·CONCRETE·BAND·STANDS·




WADING·POOL·
30'-0"
GROUND·PLAN·
·POOL·SHOWN·ABOVE·
WATER·LINE
CONCRETE·WALK
6"
SECTION·
WADING·POOL·
5'-0"
20'-0"
40'-0"
30'-0"
5'-0"
GROUND·PLAN·
·POOL·SHOWN·BELOW·
WATER·LINE·
·CONCRETE·WALK·
6
12
6
SECTION·

while improvement but the budget was smaller than usual this year and about all the available money had been spent. The wise old contractor sympathized with him but said that he would be back with a number of plans and estimates. In about a week the contractor returned with plans and estimated costs. The superintendent was favorably impressed, but saw no way out of the financial situation.



·CONCRETE·BAND·STAND·

Not in the least dismayed, the contractor called on the president of the park board and outlined the proposition. He was asked to attend the next meeting of the board and tell his story. After the contractor had talked, the board decided to review the budget to see whether or not it would be possible to build the pool this year. They found an appropriation for moving dirt that was about equal to the cost of building the pool. The contractor suggested that perhaps some of the local people would be glad to buy the dirt for the price of removal and agreed to talk the idea over with the local real estate men.

A simple, but attractive bandstand

Every interview by the contractor to sell concrete also became a call to sell dirt. A speculative builder purchased all the dirt and a good bit of concrete. The park board was pleased and bids were called for on a concrete wading pool. The good work of the contractor brought results and he was given the job.

There are seldom enough tennis courts in city parks to meet the demand

Selling Required

Certainly, landing this comparatively small job required considerable work and effort, but the value of community service cannot be measured by the job alone.

Ornamental concrete vases and stairways constitute another opportunity for the builder

The citizens complimented the superintendent and the children flocked to the pool. Likewise, the superintendent had been sold on the work of this contractor who was afterwards given an opportunity to bid on all park work. The members of the park board were influential citizens and the contractor had made contacts which were valuable in extending his business.

A similar opportunity is open to you in your own community. The extent to which it brings you new business depends upon your use of personal selling, either your own time or that of a salesman. Have you ever considered letting one of your men devote part of his time to personal selling? Give him an opportunity to try out his salesmanship. He can increase your business.

(Continued from Page 34)

Typical Method for Establishing the Weighted Size Reciprocal of Coarse Aggregate

Scheme I

Sieve Size	Per Cent of Coarse Aggregate $= p$	Average Size of Particles, In. $= r''$	$p \div 100r''$
Passing No. 4	2	0.1404	0.142
No. 4-⅜-in.	10	0.2810	0.355
⅜-in.-¾-in.	20	9/16	0.356
¾-in.-1-in.	20	⅞	0.229
1-in.-1½-in.	20	1¼	0.160
1½-in.-2-in.	15	1¾	0.085
2-in.-3-in.	13	2½	0.052
Total = Weighted size reciprocal =			$1.379 = r'$

Typical Method for Establishing the Weighted Size Reciprocal of Coarse Aggregate

Scheme II

Sieve Size	Per Cent of Coarse Aggregate $= p$	Reciprocal of Av. Size of Particle ÷ 100 $= 1 \div 100r''$	$p(1 \div 100r'')$
Passing No. 4	2	0.0712	0.142
No. 4-⅜-in.	10	0.0356	0.356
⅜-in.-¾-in.	20	0.0178	0.356
¾-in.-1-in.	20	0.0114	0.228
1-in.-1½-in.	20	0.0080	0.160
1½-in.-2-in.	15	0.0057	0.085
2-in.-3-in.	13	0.0040	0.052
Total = Weighted size reciprocal =			$1.379 = r'$

the two schemes above.

Scheme I shows the several per cents as being *divided* by the corresponding average sizes, while in Scheme II the per cents are being *multiplied* by the reciprocal of the corresponding average sizes. Both schemes, of course, give substantially the same result, but as multiplication always seems easier than division, Scheme II probably will be preferred. ***(To Be Continued)***

"Talkies" Require Concrete Construction

BECAUSE reinforced concrete has been found to be acoustically the best type of construction for the purpose, it is being used extensively in the construction of a group of buildings to be used for the production of "talkie" moving pictures, in California. Absolute silence has been achieved by concrete hanging walls and floating floors separated from the exterior buildings by dead air spaces.

The project is the Fox Movietone "city," covering about 40 acres and located at Westwood, a suburb of Los Angeles between Hollywood and the Pacific Ocean.

While the site is 12 miles from the ocean, when excavations reached a depth of from 10 to 20 ft. a very fine grade of sand was encountered. Thus it was sometimes necessary to extend the concrete piers on which the buildings rest to depth of 23 ft.

Of chief interest are two buildings each housing two stages 75 ft. wide by 100 ft. long and 30 ft. high. There are in addition a large administration building, a number of smaller buildings, a master projection room, wardrobe building, a power plant, etc. The interior concrete walls are hung from the roof to the floor level by means of steel rods suspended vertically from the roof trusses. The rods are embedded in a curtain of concrete which forms the inside wall or screen, beyond which sound cannot penetrate. The same system of suspension and dead air space is employed in the ceilings of the stages.

The walls are secured to the floating floors by strips of cork or rubber bonded to the adjoining parts. Rubber encases bolts wherever the latter are used. The inner surface of the outer reinforced concrete walls is completely lined with a layer of cork and a layer of felt, and the outer surface of the inner walls is lined with Masonite.

The floors of the inner buildings or stages rest on a bed of sand which acts as a cushion.

They are also supported by 22 vibrationless piers 14 by 14 ft. The outer walls are anchored from 10 to 20 ft. underground.

The gunite process was used to coat the curtain walls and the roof.

Included among the structures is also an 18 by 40 ft. reinforced concrete water tank extending 22 ft. underground and resting on a steel mat. Concrete going into it was poured continuously 24 hours a day for four days. Forms were built as the concrete was poured in order to withstand shifting sands. Forms were removed in 12 hours.

A portion of the concrete wall which surrounds the Fox plant

In order to complete the 17 other concrete structures now standing in the two months allotted to the work about 2300 men were employed daily, working in three shifts, each working 8 hours, exclusive of the half-hour lunch period.

The moving picture "city" is located on Fox Hills, a fairly level site on high land. It has its own power plant and lighting system, as well as elaborate heating and ventilating systems. All wires, pipes, etc., are carried underground in concrete ducts 5 by 6 ft. A 14-ft. concrete wall surrounds the buildings.

The project represents an investment of $10,000,000. George E. Miller of Beverly Hills, Calif., was the contractor.

Organizations

American Concrete Institute; Harvey Whipple, Secretary, 2970 West Grand Blvd., Detroit, Michigan.

American Concrete Pipe Association; M. W. Loving, Secretary, 33 W. Grand Ave., Chicago.

American Construction Council; Dwight L. Hoopingarner, Executive, 28 W. 44th St., New York City.

American Engineering Standards Committee; Dr. P. G. Agnew, Secretary, 29 W. Thirty-ninth St., New York City.

American Road Builders' Association; Miss E. A. Birchland, Secretary, 29 W. Thirty-ninth St., New York City.
Twenty-seventh annual convention and road show, January 11th to 18th, 1930. Atlantic City, New Jersey.

American Society of Civil Engineers; Geo. T. Seabury, Secretary, 33 W. Thirty-ninth St., New York City.

American Society for Testing Materials; C. L. Warwick, Secretary-Treasurer, Engineers' Club Building, 1315 Spruce St., Philadelphia, Pa.

Associated General Contractors of America; D. H. Sawyer, Secretary, 1150 Munsey Bldg., Washington, D. C.

Cast Stone Institute; Frank M. Brooks, Secretary, Pasadena, Calif.

Building Officials Conference of America; Col. John W. Oehmann, Secretary, 1253 Lawrence St., N. E., Washington, D. C.

Concrete Reinforcing Steel Institute; M. A. Beeman, Secretary, Tribune Tower, Chicago.

Iowa Concrete Products Association; R. L. Gavin, Secretary-Treasurer, 1002 Hubbell Bldg., Des Moines, Iowa.

National Association of Builders' Exchanges; Earl F. Stokes, Secretary, 15 E. Fayette St., Baltimore, Md.

National Concrete Products Association; A. G. Swanson, Secretary, Omaha, Nebr.

National Crushed Stone Association; J. R. Boyd, Secretary, 751 Earle Building, Washington, D. C.

National Fire Protection Association; Franklin H. Wentworth, Secretary, 40 Central St., Boston, Mass.

National Lime Association; Norman G. Hough, Secretary and Manager, 927 Fifteenth St., N.W., Washington, D. C.

National Sand and Gravel Association; V. P. Ahearn, Executive Secretary, 432 Munsey Building, Washington, D. C.

National Slag Association; H. J. Love, Secretary-Treasurer, 937 Leader Building, Cleveland, Ohio.

Northwest Concrete Products Association; W. P. Hews, Yakima, Wash.

Ohio Concrete Products Association; G. M. Friel, Secretary-Treasurer, 2284 North High St., Columbus, Ohio.

Portland Cement Association; William M. Kinney, General Manager, 33 W. Grand Ave., Chicago.

Rail Steel Bar Association; H. P. Bigler, Engineering Secretary, Builders' Building, 228 N. La Salle St., Chicago, Ill.

Wisconsin Concrete Products Association; Jack Franklin, Secretary-Treasurer, 3115 Plankinton Arcade, Milwaukee, Wisconsin.

The Concrete Industry
—25 YEARS AGO

A LARGE portion of the August, 1904, issue of *Cement Age* was devoted to a resume of information available on the subject of "Crusher Dust in Cement Mortar and Concrete." It happens that this same subject was discussed by A. T. Goldbeck in the recent meeting of the American Society for Testing Materials, reported on other pages in the current August issue.

The general opinion expressed by the engineers contributing discussions to the summary in *Cement Age* is that crusher dust does not affect the strength of the concrete adversely, through a minority expresses the belief that it is harmful.

—‡—

AN article on "Permeability" expresses the opinions of M. R. Feret, noted French engineer on that subject, as follows:

(1) The strength of mortars increases in proportion to the amount of lime or cement therein.

(2) It increases generally at the beginning of the hardening in proportion to the size of the sand particles.

(3) Mortars made with a mixture of sand containing large and small particles present practically the same advantages as those where sands of large particles are used exclusively, and should be preferred to the latter on that account.

(4) The porosity of cement mortars varies very extensively. It diminishes as the proportion of cement increases. It is much greater as the sand is finer.

—‡—

IN the August, 1904, issue of CONCRETE there is an editorial pointing out the enormous fire losses—$130,000,000 in 1903—in the United States and urging the erection of fire-safe concrete structures to cut down this loss.

That plea is of even greater importance today, for our fire losses are growing year by year and the need for fire-resistant concrete structures is more urgent now than in 1904.

—‡—

IN an article on "Concrete Building Blocks," we find this statement: ". . . they are not only artistic, but are generally made by the owner or the builder directly on the ground. This can be carried on very conveniently, though as the industry enlarges regular and extensive manufactories will be established. No better business proposition should be wanted. The cost of equipment is small; the raw materials cheap. All that is needed to make a success is the application of business principles and honest, conscientious work."

Products manufacturers, please read this and weep!

—‡—

AN editorial published just 20 years ago says: "This is indubitably the concrete age. There is no single industry in the United States today that is making such rapid strides as the application of portland cement concrete to the various forms of construction. The pioneer work has already been done. The slow, expensive development period has passed and the business is now upon a reliable and stable basis."

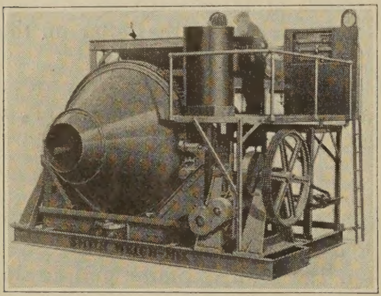
New Equipment and Materials

New Proportioning and Mixing Unit Weighs All Aggregates

The T. L. Smith Company of Milwaukee, announces the development of a new mixer attachment to permit meeting the most stringent specifications imposed by engineers.

The new device, known as the Smith Weigh-Mix, when applied to a standard Smith mixer and batch hopper, forms a complete self-contained concrete manufacturing unit. It is stated by the manufacturers that the new equipment is designed to accurately proportion all materials by weight and then thoroughly mix them.

Only one man is required to handle both proportioning and mixing operations. The controls are centralized on a platform which is so located that the operator has a full view of the entire plant, it is further stated.



An added feature is an automatic shaking device which completely cleans the hopper and allows the scale to return to balance. The speed of emptying the hopper is also considerably increased by the shaker. At no time while the hopper is vibrating does it come into contact with the weighing mechanism.

It is said that the Weigh-Mix forms an ideal unit for central mixing plants and that there is a saving effected of from 6 to 10 ft. in height.

The new Smith Weigh-Mix follows the same design as the Koehring Weigh-Mix. It can be applied to any Smith mixer now in the field.

New Portable Device for Spray Painting

The Devilbiss spray painting and finishing outfit Type NC-601 delivers a finely atomized spray adjustable from a round spray to a fan spray 3½ inches in width. It is designed for painting and finishing operations, and is complete with air compressor, ready for use. The operator merely puts the material into the paint container, plugs the electrical connection into a handy light socket and goes to work. The outfit weighs 47½ pounds, and can be easily carried from place to place. The air supply is ample, and the pressure is always constant, the DeVilbiss Company, Toledo, Ohio, states.

Hydroproof Plaster Bond New Dampness Cure

A new dampproofing remedy having an asphaltic base and known as Hydroproof plaster bond is recommended by its manufacturers, The Asphalt Products Company of Syracuse, New York, for its permanency and moisture proofness.

It is applied in the same way as paint and is claimed to adhere tenaciously to all construction surfaces. The coverage of one gallon is said to be 80 square feet of surface with one coat or 50 square feet with two coats.

Truscon Announces New Steel Road Form

A new steel road form to which joint locks and other built-up parts are attached by 3/16 in. hot-driven rivets is being manufactured by the Truscon Steel Company of Youngstown, Ohio.

The manufacturers point out that contractors using forms with rivet-attached joint locks and other parts easily and quickly replace broken or damaged parts on the job without special equipment. Either bolts or rivets may be used in making such repairs.

The new forms are completely interchangeable, each form is equipped with a male element on the adjacent end of the next form, thus making true alignment of joints always certain. A seven-inch sliding member is driven through keyways on each two adjoining forms and is held by two stakes to form a rigid joint.

The stakes are each 3½ in. from the joint, giving double support where it is most needed. Other stakes may be used wherever necessary between joints. Crooked stakes cannot throw forms out of alignment at joints.

The new forms will take bends of 100 ft. radius, which is said to be 150 ft. shorter radius than is required in standard specifications for the use of steel forms. The short radius is obtained by the short locking apparatus at the joints.

Another outstanding point of the new forms is that they can be combined with any other Truscon form, even the first ones manufactured by the company. Forms of different heights can be joined to give perfect alignment and joints of positive rigidity.

Because of the uniformity of Truscon forms resulting from the method of their manufacture, it is contended that roads built with them will be relatively free from waves and irregularities. The distinct shape of the top rail of the Truscon form permits the finishing machine to rest on the inside wall of the form rather than on the outside edge of the head, thus saving 2½ per cent or more of the concrete, it is also stated.

New Slide-Lock Molds Simplify Concrete Testing

Slide-lock molds for testing concrete are a new device designed to simplify testing, featuring simplicity of operation and ease of handling.

The Slide-Lock mold is made of sheet steel. Heavy dovetail guides, one at each side of the seam, form the lock. The slide draws and holds the mold with the seam entirely closed. The base plate is designed to insure a flat, true surface and facilitate moving the cylinder to safe storage immediately. The mold has a simple, one-hand carrier, according to the Los Angeles Testing Laboratory, Los Angeles, Calif., who manufactures it.

NOTES FROM THE FIELD

Wallace-Towsley

J. D. Wallace & Co., Chicago, manufacturers of portable woodworking machinery, have taken over the *John T. Towsley Mfg. Co.* of Cincinnati, manufacturers of large woodworking machinery and factory trucks.

The present Wallace national sales organization and engineering service will be the basis of an expansion program which will, it is said, eventually cover every standard need of the woodworking industry in modern production machinery in various price classes.

Johns-Manville Office

Johns-Manville Corporation, New York, announces the removal of the Milwaukee sales office of its western division to the Railway Exchange Building, 97 East Wisconsin Avenue, Milwaukee.

There Is NO "Or Equal"

—When it comes to integral waterproofing for concrete, cement stucco and cement mortar. If anyone tries to tell you that there is an "or equal" to Truscon, investigate for yourself and see if that waterproofing can protect you with ALL the following—

1. **Fully Guaranteed**
2. **Easy to Use** (add directly to mix from drum)
3. **Plasticizes Concrete**—Minimizes Segregation
4. **Backed** by a $20,000,000 Company
5. **Proved in World's Most Famous Structures**
6. **High Concentration** (lowest cost per yard)
7. Contains **NO Calcium Chloride** or Soluble Salts to rust reinforcing steel.

No other integral waterproofing can give you as much service, satisfaction or peace of mind as Truscon. If use dating back to the earliest days of concrete means anything—if what the leading architects and contractors have to say is an influence—if the reputation and responsibility of the Company is a factor—if economy, freedom from harmful ingredients, ease of use and guarantee features are worth while—they all point to the fact that you should specify and use Truscon Waterproofing Paste Concentrated in concrete, cement mortar and cement stucco.

Write for free data on the practical uses of
Truscon Waterproofing Paste Concentrated

THE TRUSCON LABORATORIES · · DETROIT, MICHIGAN
OFFICES IN ALL PRINCIPAL CITIES · · FOREIGN TRADE DIVISION, NEW YORK

Specify **TRUSCON**
Waterproofing Paste

With the Manufacturers

INDUSTRIAL LITERATURE

"Besser Tampings"

"Besser Tampings" is a new four-page publication of which "Batch No. 1" is just being distributed by the *Besser Manufacturing Company,* Alpena, Michigan.

It carries a message from J. H. Besser, president, followed by illustrations and some matter descriptive of Besser equipment.

Master Builders Product

The subject of concrete floor wear is treated extensively in a 28-page book prepared by the *Master Builders Company,* Cleveland, Ohio.

"The Fifth Ingredient," as it is named, concerns itself principally with the Master Builders new metallic hardener known as Omicron.

International Cement Folders

Two interesting, new folders prepared by the *International Cement Corporation* concern its high early strength cement Incor. The first, entitled "A New Record with 'Incor'" concerns three large structural projects. The other, "Saving Time for the Highway Builder," illustrates instances of the use of the cement.

On Medusa Cement

The Medusa Portland Cement Company, Cleveland, Ohio, has prepared a new publication descriptive of its waterproofed gray portland cement. Its contents comprise illustrations of a graphic test of waterproofed cement, directions for making good waterproofing concrete, the proportioning of concrete mixtures, the design of concrete mixtures, illustration of the slump test, how to make existing work waterproof.

These are followed by specifications for concrete swimming pool construction, concrete block, and for general construction.

Huron Leaflet

The fundamentals of using concrete "for the man who farms or owns a home" are contained in a small six-page leaflet published by the *Huron Portland Cement Company,* Detroit, Mich.

It is entitled "Practical Notes About Huron Concrete" and explains what concrete is, the method of mixing, and the Huron free service.

On Colloy

A new publication issued by the *Colloy Products Company,* St. Louis, Missouri, deals with the colloidal workability admixture known as Colloy and goes into some detail on such subjects as segregation, workability, drier consistencies, and improved watertightness.

Rail Steel Manufacture

The Rail Steel Bar Association, Chicago, Ill., has prepared a 16-page publication that is "presented to describe the rail steel industry, the manufacture of rail steel bars and the use of this material in reinforced concrete construction."

Brief descriptions of each operation are followed by outlines of the properties and specifications of rail steel.

All About Celite

A new twenty-four page illustrated circular entitled *"Celite for Concrete"* is just off the press and received from *Johns-Manville,* New York City. Some of the chapter titles are "What Celite Is," "How Celite Is Used," "How Celite Improves Workability," "The Effect of Celite on Strength and Uniformity," "Celite Insures Maximum Watertightness," and "Specifications Covering Use of Celite in Concrete."

Concrete Hauling Trucks

A six-page folder published by the *Portland Concrete Machines Co.,* Chicago, Illinois, deals with R. M. C. concrete delivery tanks, illustrated in numerous positions.

The R. M. C. tank, it is explained, is built in four sizes, of 2, 3, 4, and 5 cu. yds. capacities, and is a completely assembled units consisting of a cylindrical steel tank mounted on a heavy steel underframe and supported at each end by large trunnion shafts. It may be attached to any heavy-duty truck.

Servicised Products

In addition to expansion joint, the recently distributed *Catalog No.* 12 of the *Servicised Products Corporation,* Chicago, Ill., deals also with waterproofing protection courses and rail filler.

Marquette Super Cement

Marquette Super Cement Concrete is the subject of a *Marquette Cement Manufacturing Company* booklet of 24 pages. A variety of structures in whose construction the cement was used are illustrated and described.

Slag Resistance

"Resistance of Slag and Slag Concrete to Certain Destructive Agencies" is the title of a 36 page symposium on the subject prepared by the *National Slag Association,* Cleveland, Ohio. It deals in the following sequence, with tests of slag, tests of slag-lime bricks, of slag concrete, the resistance to corrosion of slag concrete, slag admixture in concrete, weathering of such concrete, of slag, and of slag cements.

Other headings concern the density of concrete and durability.

Jaeger Hoists and Pumps

Bulletin P-29 published by the *Jaeger Machine Company,* Columbus, Ohio, concerns principally its new "Speed Boy," 8000 g.p.hr. unit. It describes and illustrates also other diaphragm, plunger, lift and force centrifugal pumps.

Another 8-page publication, Bulletin J T 101, is devoted to the Jaeger material tower.

"The Good Mixer" another Jaeger publication, furnishes a source of mixer sales "pep." It appears from time to time, and is modeled along newspaper lines.

"American" Gasoline Crane

The American Hoist & Derrick Company, St. Paul, have just issued a new Three-Speed Gasoline Locomotive Crane book. This book describes how the advantages of both the steam operated and the gasoline operated locomotive cranes are combined in their three-speed gasoline crane with automotive gear shift. This locomotive crane is not a steam crane "revamped" but has been designed from the very start for gasoline operation, the manufacturer states.

Wherefores of Fluresit

A new 16-page booklet of a size convenient and prepared for filing, on the subject of *Fluresit* waterproofing is being distributed. It deals with the product's economy, its results in tests, specifications, and directions.

The American Fluresit Company, Cincinnati, Ohio, is the distributor.